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A
TREATISE
ON
VENTILATORS.

WHEREIN

An Account is given of the Happy Effects of the ſeveral Trials that have been made of them, in different *Ways* and for different *Purpoſes*: Which has occaſioned their being received with general *Approbation* and *Applauſe*, on account of their Utility for the great Benefit of Mankind.

AS ALSO

Of what farther Hints and Improvements in ſeveral other uſeful Ways, have occurred ſince the Publication of the former *Treatiſe*.

PART SECOND.

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HONI SOIT QUI MAL Y PENSE

G.R. III. BR. MUS.

A SECOND PART TO THE TREATISE ON VENTILATORS, &c.

237.(*) AS Ventilators are found to be greatly and extenſively beneficial to Mankind, ſo as thereby to have a conſiderable Influence on the Affairs of the World, it will hereafter be Matter of Wonder, that ſo plainly ſelf-evident a Benefit ſhould be ſo many Years propoſed before the World could be prevailed on to receive them; which proceeds from a general Backwardneſs to every new Propoſal, not caring to give themſelves the Trouble thoroughly to conſider and examine them. But it is reaſonable to believe, that Ventilators will, from Time to Time, come into more general Uſe, not only for the ſeveral important Purpoſes here mentioned, but alſo for many other, at preſent unthought-of Uſes, to the great Benefit of Mankind.

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* The Paragraphs are here numbered, in a continued Series, from the laſt of thoſe in the firſt Volume, that References may thereby be the better made to and fro' to either Volume. The Subject-Matter in this being placed in the ſame Order, as in the firſt Volume. The Plates and Numbers of the Figures are continued on alſo in the ſame Manner.

238. New Diſcoveries are apt to be deſpiſed, eſpecially by thoſe who are incompetent Judges of them; and that, no Wonder; for we are Slaves to old Habits and Cuſtoms, even to the Degree of ſuffering Inconveniencies, which we might eaſily remedy. And this very Diſpoſition, is ſometimes beneficial to us, as it enables us the better to bear Inconveniencies, which we cannot remedy. But in all other Caſes where a Remedy can be had, it is renouncing our Reaſon, blindly to follow the old Track we are in, only becauſe it is a beaten one, or becauſe we will not give ourſelves the Trouble, to enquire whether we cannot find a ſhorter and more commodious Way.

239. Yet this is the Caſe of the Generality of Mankind, who, influenced by narrow Motives, do not give themſelves the Trouble to examine into Matters, the leaſt removed from their limited Sphere of Thinking and Acting. This proceeds from a Remiſſneſs in Mankind, in acquiring Knowledge, and improving the Talents which God has given them. It is to be remembered, that new and uſeful Diſcoveries, are not the Product of ſuch lazy ſleepy Reaſonings as are commonly to be met with, but the Reward of careful and diligent Reſearches. For the Power of a proper Series of Experiments for making new Diſcoveries is very great; when Men will have Patience to proceed in the humble Way of repeated Trials, ſtill endeavouring to make farther and farther Advances; mending the Defects of former Trials and Experiments, without which Method of Proceeding, few uſeful Diſcoveries would be made.

240. And the more important the Reſearch is, ſo much the more diligent ſhould we be in our Enquiries after it. And ſuch is the Subject of our preſent Enquiry, *viz.* How to preſerve the Health and Lives of Men in Ships; as alſo the Ships from decaying,

ing, when laid up in Ordinary. And as the Malady in both Caſes, principally ariſes from damp, foul, ſtagnant, cloſe confined, putrid Air, ſo the obvious and only Remedy is, to exchange the Air of Ships ſo often, as not to give it Time to putrify. And, when probable and proper Means for doing it are propoſed, one would be apt to think, that all ſhould readily approve of ſo ſelf-evidently reaſonable a Propoſal, and not ſupinely reject it. But, notwithſtanding, it has been received for many Years, with great Coldneſs by ſome, and Contempt by others; yet it has at length prevailed, ſo as to be brought by repeated Trials, to more and greater Perfection; to the great Benefit of Mankind, not only in relation to Ships, but alſo in many other Reſpects.

241. THOSE who are ignorant of, or do not conſider the Reaſon of Things, and are uſed only to the practical Part, and habitually execute what they have been taught; ſuch are mere Copyiſts, who ſervilely follow the Track which has been traced out for them: Wholly taken up in Copying, they conſider not the Reaſons why Things are done ſo, or ſo; they have no Deſire to do

better. They ſeem to be of opinion, that the Maſters, of whom they learned, had brought Things to the utmoſt Perfection; not conſidering how little we know, in compariſon of what we are ignorant of, and that conſequently there will ever be Room for more and farther Improvements, and uſeful Diſcoveries. If any new Thing is propoſed to them, they reject it without examining, or elſe without duly weighing, the Advantages, or Inconveniencies they labour under; they only endeavour to raiſe Difficulties and make Objections, and to find Reaſons for going on in their old Way.

242. The ingenious Author of the Letters, called Sir *Thomas Fitzoſborne*'s, Vol. II. Letter 506. obſerves, 'That there is not a more
'ſingular Character, than that of a thinking
'Man.— That Thinking is one of the laſt
'exerted Privileges, even of cultivated Hu-
'manity.— That Pride and Indolence great-
'ly contribute, to keep this Faculty of the
'Soul unemployed.— For this Reaſon, the
'greater Part of our Species, generally chooſe,
'either to ſeize upon their Concluſions at
'once, or to take them by Rebound from
'others, as beſt ſuiting with their Vanity or

‘ Lazineſs.— This will account for the ſlow ‘ Steps, by which Truth has advanced in the ‘ World on one Side, and for thoſe abſurd ‘ Syſtems, which at different Periods, have ‘ had an univerſal Currency on the other.’ It is the juſt Obſervation of the Poet, *viz.*

‘ Cuſtom, that Reaſon’s Foe ſo oft appears,
‘ Inchants whole Millions to her wide Com-
‘ mands,
‘ Lo ! gaping Multitudes the Nod attend,
‘ Revere her Dictates, and her Laws defend.’

Henry Jones’s Poems, p. 153.

243. NOT that I am pleading for a blind, precipitate Receiving of all new Propoſals ; this would be to run into another dangerous Extreme, For there are many more, improper, injudicious, trifling, new Propoſals projected, than there are judicious uſeful ones. So that it is right, not to receive new Propoſals, even tho’ they ſeem very uſeful and important, till their Reaſonableneſs and Practicableneſs are thoroughly examined by competent Judges. For when we follow long-beaten Tracks, as we know both the good and bad of them, we can act accordingly ;

ly; but, in new Things, which do not promiſe very great Advantages, there may be unforeſeen Defects. On the other hand, tho' the moſt promiſing Diſcoveries may have ſome Inconveniencies, yet they are not to be rejected by conſiderate Perſons, who will endeavour to rectify what is amiſs, and alſo to make farther Improvements thereon. Many of the Difficulties are often foreſeen, by ſuperficial Thinkers; but, to remove the Difficulties, and to make the beſt Uſe of the Benefits of Diſcoveries, requires more Candor, Thought, and judicious Conſideration. It is very right to make juſt Objections to new Propoſals, that the Merit or Demerit of them, may be the more thoroughly examined. But the Objections of the Prejudiced, and of incompetent Judges, when they are of no Weight, ought not to diſcourage us in the Purſuit of uſeful and new Diſcoveries. For, as it is obvious to obſerve, that a conſiderable Part of Mankind do not think for themſelves, but run in with the Stream of current Opinions, it being in many Caſes for obvious Reaſons beſt for them ſo to do; ſo neither ought the Diſapprobation, or Approbation of ſuch, to be of any Weight.

244. THE Tops and Bottoms of Ventilators may be nailed with thin Laths of Board under the Heads of the Nails, by this means the Nails may eaſily be drawn out without damaging the Boards, when the Laths are ſplit away; and, in order to prevent the Inconvenience of the ſwelling and ſhrinking of the Midriffs (*Num.* 4.) by Moiſture or Drineſs, the following Method is found effectual, *viz.* to have Tenons of the ſhort Rails, to reach thro' the Mortices of the long Side-Rails, and to be pinned near the outer Edge of the long Rails, and to have a dove-tail Faſtening by means of Wedges, dipped in Glue, drove in at the Ends of the Tenons, whereby on the ſwelling or ſhrinking of the long Rails ſideways, theſe Rails may have Room to ſwell and ſhrink inwards, on the Tenons of the ſhort croſs Rails, on about a Quarter of an Inch of Space left for that Purpoſe, between the Shoulder of the Tenon and the long Rail. The Pannels are to enter into deep Grooves, thereby to allow Room for their ſwelling and ſhrinking. And as the Boards which cover the Tops and Bottoms of the Ventilators lay acroſs them, therefore the Sides of the Ventilators will not be either drawn in or puſhed out, by the Drineſs or

Moiſture of the top or bottom Boards, becauſe Fir lengthens and ſhortens very little by Moiſture or Drineſs, as I have found by many Trials. It may be well alſo to keep the Side-Boards at a due Diſtance, by a croſs Bar or Strut, fixed within from Side to Side, near the Middle, yet ſo as not to hinder the riſing and falling of the Midriffs. By which Precaution the Edges of the Midriffs may approach the nearer to the Sides of the Ventilator; and thereby they will not only convey much more Air, but alſo a great deal of fruitleſs Labour will be ſaved, by preventing a large Eſcaping of Air at the Edges of the Midriffs. The Ventilators may alſo be ſomewhat the leſs, which in ſome Caſes may be of Importance. The Lengthening and Shortening of the Midriffs lengthwiſe will be very inconſiderable, becauſe the long Rails reach the whole Length. The Ventilators need not be ſeparated, as in *Fig.* 1. *Plate* 1. but joined cloſe together.

245. BROWN Paper made of tarred Ropes, is proper for paſting over the Seams of Ventilators, becauſe it will not tear when the Boards ſhrink, and probably Rats will not eat it. Mr. *Yeoman* finds it beſt to nail Battings

acroſs the Bottom and Top of Ventilators, ſo as to have them like a Door, to open, and lift off all together, to be faſtened down with ſeveral Wood Screws or Haſps. He covers the whole Surface of the Valves with tanned Sheeps Leather, which ſerves alſo for Hinges; and finds, that, in order to abate the Noiſe of the Valves in Hoſpitals, it is proper to have them narrow, but long.

246. HINGE Ends of the Midriffs may be very cloſe to the Valve-board or Frame, if the Iron Axils be flat on one Side, and rounding on the other; whereby they will keep cloſe to the Valve-board, though moved a little circularly by the riſing and falling of the Midriff. The Axils *z*, *c*, *x*. *Fig.* 12. *Plate* 3. are to be fixed with their flat Side to the Ends of the Midriffs, not only with Wood Screws, but alſo with broad Tenons of Iron, wilded and incorporated into the Axils; which Tennons enter into Slits or Mortices, cut at the Ends of the long Rails, the Ends of which Rails are ſtrengthened by long Iron Plates *dd* on both Sides, faſtened with Wood Screws, through which, and the Iron Tenons, Iron Pins paſs, which are ſcrewed faſt with Nuts to the Staple. *Fig.* 13. a Section of the End

of two Ventilators at the circular End, laid on each other, ſhewing the Iron Rods *ff*, the Staples *gg*, and Ends of the Midriffs *ee*.

247. The upright Iron Rod *z*, *Fig*. 2. *Plate* 1. will work up and down very freely in a ſmall Hole, in a ſquare moveable Iron Plate, which moveable Iron Plate is covered with a ſomewhat larger hollow fixed Plate, with a wide Hole in it.

248. Some work the ſmall Ventilator, *Fig*. 6. *Plate* 1. by a long Lever parallel to the Midriff, one End of which is fixed at R to the Iron Rod R, *z*. the other End of this Lever reaching as far as to the other End of the Ventilator, and is ſupported by an upright Standard of Wood fixed on the Ventilator, at the Diſtance of about one third of its whole Length from R, whereby a like larger Ventilator may be worked with the greater Eaſe, *viz*. becauſe the greateſt Force, which is requiſite for raiſing the Midriff, will be exerted, by puſhing down the farther End of the Lever, which a Man can do with greater Eaſe than he can lift up the like Weight when he is in a ſtooping Poſture.

249. *Numb.* 16. MENTION is made of the *Heſſian Bellows*, or a Wheel in a Drum. The Defect and Deception of this Inſtrument lies in this, *viz.* that the Velocity and Force of the Air which is thrown out by the circulating Fans, is but in a very ſmall Degree proportionate to the Velocity of the Fans, becauſe the Force and Velocity of that Air is only equal to the centrifugal Velocity given by the circulating Fans, multiplied into ſo rare a Fluid as the Air is; which can be but little, and is in part abated by the Reſiſtance of the ſtagnant outward Air. Whereas were Water thrown out by ſuch an Engine, the centrifugal Velocity of ſo denſe a Body as Water, would bear by thirty Times a much nearer Proportion to the Velocity of the circulating Fans, and the proportionate Reſiſtance of the outer Air to the ruſhing-forth Water would be very inconſiderable. And farther, to confirm this Reaſoning, ſuppoſe the Noſe of the ſmall Ventilators, *Fig.* 6. *Plate* 1. were fixed to the Noſe of the Drum Bellows, and that both Engines were worked at the ſame Time, it is evident that the Air which is blown from the Ventilators, it having no other Way to retreat, would be ſuperior to the Force of the Air from the Drum, which is no more than its centri-

fugal Velocity multiplied into its very rare Subſtance; and conſequently the Air in the Drum would be repelled to the Centre, *&c.* The contrary of which would be the Event, if the Force of the Air in the Drum, and conſequently its Velocity, were greater than that of the Air from the Ventilators. And accordingly, on repeated Trials by ſeveral Ways, I found the Quantity and Force of the Air thrown out by the ſmall Ventilators, *Fig.* 6. to be much greater than the Quantity of Air which was thrown out by a centrifugal Wheel, which was about ſeven Feet in Diameter, and about eighteen Inches wide: And withal, more Labour was required to turn the Wheel than to work the Ventilators.

250. As to Hoſpitals, where Ventilation is to be uſed with proper Caution, it may be well, eſpecially in the Caſe of ſome Diſtempers, to draw the Bed-Curtains cloſe, not only during the Ventilation, but alſo for a few Minutes after each Ventilation, *viz.* till the cool freſh Air is well warmed, and blended with the warm Air of the Room.

251. It is well known that the foul, putrid Air of Hoſpitals is a great Diſadvantage to the

Patients; and this not only conſumptively-inclined Perſons are ſenſible of, but alſo thoſe who, otherwiſe in good Health, are put into Hoſpitals for broken Limbs, where they get the Hoſpital Diſtemper, which they would not have had in the purer Air of a private Houſe; as do many alſo whoſe Diſeaſe requires their long Continuance there. Surgeons alſo obſerve, that Wounds do not heal ſo well in ſuch foul putrid Air, as they will do in a purer Air. Whereas, if the Air of Hoſpitals were changed every Day, Morning and Evening, for a little Time, ſo as not to have Time to putrify, it is probable that many Patients would recover ſooner, and that fewer would die in ſuch purer Air; which would have this further Advantage, to make the Charity of Hoſpitals more extenſively uſeful, by making Room for a quicker Succeſſion of Patients.

252. THE firſt Trial of Ventilators in an Hoſpital, was made in the County Hoſpital at *Wincheſter*; where they are fixed under the Floor, at the farther End of the Ward from the Entrance, yet ſo as to be worked with great Eaſe by thoſe in the Ward, by means of a Lever F, G, *Fig.* 2. *Plate* 1. fixed acroſs the Ward between the Beds. The Midriffs

of the Ventilators are each ſeven Feet long, and three Feet wide. The Ventilators are not ſeparate, as in *Fig.* 2. but have only one common Partition of thick Plank. The Air is drawn out of the Ward through a large Trunk, which reaches near up to the Ceiling, that it may not incommode the Patients with the Velocity with which it ruſhes into the Trunk; which Velocity is ſo great, as to twirl faſt round a little Wind-mill placed at the Mouth of the Trunk. And in Caſes where ſuch a Wind-mill cannot be ſeen by the Workers of the Ventilators, then the Wind-mill may be made to make a very ſmall tinkling Bell to ſound, as was done at *Newgate*, when the firſt Ventilators were worked by Hand, and as is done in *Durham* County Goal, with a very ſmall Bell. The like twirling Wind-mill is found to be of conſiderable Uſe in diverting, and thereby encouraging thoſe who work the Ventilators to perſiſt in working; without which ſenſible Amuſement they are apt to be diſcouraged from working the Ventilators; becauſe, as it has been found by Experience, they are apt to look upon it as working to no Purpoſe, ſince they can ſee no viſible Effect that it has on the inviſible Air.

253. This Ward being filled with the Fumes of burning Pitch, they were drawn off, and diſpelled by the Ventilators, through Trunks which conveyed them out into the open Air, in nine Minutes, notwithſtanding the Length of the Ward is fifty-eight Feet, and its whole Capacity equal to 278 Tuns. When the farther Door was ſhut of another long Ward, which communicated with this by a long Paſſage, on working the Ventilators, the Smoke was drawn down the Chimney of that Ward; and with ten Minutes Ventilation the Ward was ſenſibly ſweeter.

254. As to the Degrees of Refrigeration made thereby, Mr. *Pratt*, Apothecary, and Secretary to the Hoſpital, ſent me the following Obſervations, made with *Farenheit*'s mercurial Thermometer, which was graduated like that deſcribed *Numb.* 197. which was hung on the Bed next to the open Door of the Ward, till the Mercury was got to a ſettled Point; when, on working the Ventilators, the Difference was, *viz.*

December 24.

External Air above freezing	4 Deg.
In the Ward - - -	18
After ventilating 5 Minutes	17
10 Minutes	15
15 Minutes	15

December 26.

External Air - - -	6
In the Ward - -	19
After 5 Minutes Ventilation	18
10 Minutes - -	17
15 Minutes - -	16
20 Minutes - -	15½

December 28.

External Air into freezing -	2
In the Ward above freezing	12
After 5 Minutes Ventilation	11
10 Minutes - -	10
15 Minutes - -	9 { or ſomething more.
20 Minutes - -	8½

Hence we may obſerve, that when, *Dec.* 28. the external Air was ſo cold as to be 2 Deg. into freezing, and the Air in the Ward 12, that on 20 Minutes Ventilation the Air of the Ward was refrigerated 3 + ½ Degrees, *viz.* to 8 + ½. And farther in the Ward from the Door, the

Refrigeration was leſs, and in warm Weather the Refrigeration by Ventilation will be much leſs: The Degrees of Ventilation muſt therefore be more or leſs in proportion to the different Temperature of the Air as to Warmth or Coldneſs, Moiſture or Drineſs, which will be beſt determined by Experience. The two principal Times of Ventilation ſhould probably be Mornings, and Evenings before the Dew falls; the firſt to carry off the frowzy Air of the whole preceding Night, the latter to ſupply the Ward with Store of freſh Air for the Service of the Night. Ventilation will not only be of uſe to the Patients in many Reſpects, but will alſo be very beneficial to the Phyſicians, Surgeons, Apothecaries, and Nurſes, who attend them. During Ventilation, all or ſome of the Bed-curtains may be drawn, eſpecially in ſome Diſeaſes, and during the colder Conſtitution of the Air. This is what is practiſed in ſome Hoſpitals, when Windows are ſet open to air them.

255. THERE are Ventilators alſo in *St. George*'s Hoſpital, near *Hyde-Park-Corner*, whoſe Midriffs are each nine Feet long, and four and a half Feet wide. They are fixed on the Top of the Houſe, and are worked by a

Wind-mill. From the Ventilators there goes a Trunk, a Foot ſquare in the Clear, to the three large Wards on the weſtern Side of the Hoſpital, which are over each other, and extend North and South. From the above mentioned perpendicular Trunk, there is near the Cieling of each Ward a like Trunk, which reaches from near the Door of the Ward to the farther End of it, *viz.* about Seventy-five Feet; where the foul Air being drawn into the Trunk, the ſucceeding freſh Air enters at the Ward-door, and thereby drives out the foul Air before it; and the like Trunks are fixed in the Wards on the eaſtern Side of the Hoſpital. But the freſh Air muſt by no means enter at the Windows in cold Weather, becauſe ſuch cool Air will fall precipitately down thro' the warmer Air of the Ward, and thereby greatly incommode the Patients; whereas by entering principally at the lower Part of the open Door-caſe, that Inconvenience will be avoided: Or Holes might be made thro' the Wall, for the Air to enter the Wards from the Stair-caſe; by which means the foul Air at that End of the Ward will be drawn to the other End of the Ward, and thence be drawn off by the Ventilators. The Doors ſhould be always open while the Ventilators are working. There are alſo Air-trunks to ſeveral leſſer Wards, as alſo to a foul Ward.

256. As ſeveral of theſe Wards may thus be ventilated at the ſame Time, and as the Change of Air will therefore be ſo very gentle as to be in a manner inſenſible; therefore the Ventilation may be continued much the longer, with great Safety to the Patients.

257. SOME are apt to think Ventilators uſeleſs in Hoſpitals, becauſe they can in good warm Weather air the Wards by opening the Windows, and that doubtleſs much better than by Ventilation; and were there ſuch good kindly Weather all the Year round, then Ventilators would be uſeleſs. But ſince, for the greateſt Part of the Year, the external Air is too cold to be admitted in at Windows, becauſe it is a well-known Truth, *viz.* that cold Air admitted into the upper Part of a warm Room, being ſpecifically heavier, falls precipitately down thro' the warmer Air. And this it muſt doubtleſs do in the warm Wards of an Hoſpital, ſo as to incommode and endanger the Welfare of the Patients; beſides that, the Indraft of Air at open Windows will

be much greater than what comes in by the more gentle Method of Ventilation: Beſides this further great Advantage, that the freſh Air drawn in by Ventilators, principally enters the Wards at the lower Half of open Door-caſes, as is plain to be ſeen by holding a lighted Candle at the lower and upper Parts of an open Door-caſe; or elſe the freſh Air may be conveyed into ſome Wards, by Trunks placed near the Floor, as is done with good Effect in 32 Chambers in the Small-Pox Hoſpital at Sir *John Oldcaſtle*'s. It has been ſaid, that ſome Hoſpitals ſtand in ſo open and airy a Situation, that they have no Occaſion for Ventilators; yet it is well known, that notwithſtanding Ships at Sea are in ſo airy a Situation, that Millions of People have loſt their Lives there by the Foulneſs and Putridneſs of the Air in Ships; which Inconvenience is effectually prevented by Ventilators, as is now fully proved by repeated Experience in many Ships, which the People on board are ſo ſenſible of, that they work the Ventilators with Eagerneſs.

258. THERE are Ventilators alſo fixed in the County Hoſpital at *Northampton*, which ventilate three Wards over each other: they

are fixed to the Cieling of the middle Ward to ſave Room, and are worked in the upper Ward by a Bed-ſide. They are fourteen Inches deep in the Clear within, and their Midriffs ſix Feet long, and three Feet nine Inches wide. They have not wanted any repairing in ten Years, tho' worked conſtantly three or five times a Day.

259. THE lower Ward contains 125 Tuns of Air, the middle Ward 313, and the upper Ward about 230 Tuns. Small twirling Wind-mills may be fixed in each Ward, where the Air is drawn into the reſpective Trunks of the Ventilators; which are found to be of uſe, not only to divert and amuſe thoſe who work the Ventilators, but alſo to let the Patients in each Ward know that they have their due Proportion of Ventilation.

260. THE Ventilators are fixed in an Hoſpital at *Briſtol* in a different Manner from any of the above mentioned, *viz.* one of the large Ventilators, *Fig.* 2. is placed in an inverted Poſition directly over the other, leaving a void Space between them of about 20 Inches Depth; in which Poſition the Iron Rods R, z, are worked up and down by a Winch, which has two crooked Cranks in its Axil,

to which the Rods are fixed. But as by this means the Motion of the Rods is very oblique, it was therefore neceſſary to have the Holes at *z z* very large, and conſequently requiſite to have leathern Bags nailed round the Holes *z z* at one End, and tied to the Bars at the other End. This Manner of fixing Ventilators may be commodious in Places where there is not convenient Room for the other Manner of placing and working them; but then they require ſomewhat the greater Force to work them, on account of the great Obliquity of the Rods.

261. In the Year 1752, a Pair of double Ventilators were put into an Hoſpital for the Small-Pox at Sir *John Oldcaſtle*'s, near *London*. Their Midriffs were ſeven Feet long, and three Feet wide. The Houſe was four Stories high, with Galleries on every Floor, on each Side of which were four Chambers, with vacant Spaces in the Middle, in which there was a Chimney. In the Middle of one of theſe Galleries the Ventilators were fixed up to the Cieling, where the Lever was commodiouſly worked up and down by means of long Iron Rods fixed to it at F and G, *Fig.* 2, the lower Ends of which Rods were fixed to ſhort

Levers, one End of which worked on Iron Pins fixed in the Sides of the vacant Space where the Chimney was. By means of Trunks branching from the larger perpendicular ones, all the thirty-two Chambers were ventilated in their Turns, *viz.* the eight Rooms of a a Gallery at a Time, by having the foul Air drawn with a cautious Hand thro' a Hole four Inches ſquare, near the Cieling of each Room, in which were two Patients, the freſh Air entering thro' a long Trunk under the Bed on the other Side of the Room; which Trunk is full of ſmall Holes, eſpecially at its farther End, thereby not only to prevent the Inconvenience of a large Stream of Air in one Place, but alſo to convey ſome of the freſh Air to the farther Side of the Room, and by that means impel all the foul Air ſo as to have it drawn out. The foul Air is conveyed by a Trunk thro' the Roof of the Houſe, in a Valley, where the upper Part of the Trunk is turned horizontally, to prevent the Entrance of Rain. In caſe it may not be proper to ventilate any particular Wards, there is a Valve to prevent the drawing out of any Air. The Midriffs were ſeven Feet long, and three wide. There are now many more Chambers aired by the ſame Ventilators. This is no Annoyance to the Neighbourhood.

262. THIS Ventilation cauſes the Hoſpital to be in a manner as ſweet as a private Houſe. And it is obſerved, that fewer by more than one Third die, ſince the drawing the foul putrid Air out of the Chambers by Ventilation; and it is reaſonable to think, that the Danger of ſo putrid a Diſtemper as the Small-Pox is, will be much greater in a foul putrid, than in a purer Air. The good Effect of this Method, will probably lead to the not keeping the Chambers of the Sick very cloſe in private Houſes.

262. As Ventilators were firſt fixed in *Wincheſter* Hoſpital, ſo were they firſt uſed in that Goal, which are found to be of great Benefit to the Priſoners, in freeing them from the intolerable Stench of a foul, cloſe, putrid Air, by often drawing it off, and introducing freſh Air. They are fixed up to the Cieling of the Debtors Room, as well that they may be out of the Reach of the Priſoners to damage them, as alſo that they may take up none of their Room; where they are worked by the Lever F, G, which is placed near a Wall, thereby

ventilating both the Debtors Room and the Criminals Dungeon, or Night-Room. The Priſoners enjoyed good Health for more than two Years after they were fixed there, *viz.* till two Fellows from *Reading* Goal, who had the Goal Diſtemper, firſt gave it to a Man who ſhaved them; and ſome time after eight more were ſeized with it, who were all in the ſame Day-Room, in which the Felons had been till they were executed; and no more than thoſe eight were ill of that Diſtemper for a long Time after: An evident Proof, that the Felons brought the Diſtemper there. The Goal Diſtemper is of ſo infectious and peſtilent a Nature, that it is well known, by many Inſtances, to have been carried a great Way in the freſh open Air; and may well therefore infect in cloſe Priſons, notwithſtanding the Wards are ventilated to ſuch a Degree, as very ſenſibly to refreſh them. Yet it is very probable that the like Degree of Ventilation, might effectually prevent the Breeding of Goal Diſtempers, which are chiefly occaſioned by a high Degree of Putrefaction of foul, long-confined, ſtagnant Air. Thus Silk-Worms are deſtroyed by their own Stench.

263.

263. It were therefore to be wiſhed, that the Priſoners which are removed from unventilated Goals, to thoſe which have Ventilators, were carefully kept in ſeparate Wards, till Ventilators are put into all Goals. For, tho' Ventilation will effectually prevent the firſt Breeding of the Goal-Diſtemper, yet it will not cure it, nor prevent its ſpreading Infection. Which ſhews how reaſonable it is to have all Goals thus ventilated, thereby to prevent the Breeding of that peſtilential infectious Diſeaſe, called the Goal-Diſtemper.

264. Many are apt to think, that there is no Occaſion for Ventilators in thoſe Priſons, which have an open Area or Court, for the Priſoners to air themſelves in. But this is a great Miſtake: For there are many Inſtances of the Goal-Diſtemper's being bred, and deſtroying many in Goals with open Courts. This was frequently the Caſe in the *Savoy*, before Ventilators were fixed there to change the foul putrid Air of the Wards. And in the *Fleet* Priſon an hundred died of that Diſtemper in the Winter, between the Years 1753 and 1754, notwithſtanding there is a large Area. And it is notorious, that Millions of Mankind have been deſtroyed by the noxi-

ous putrid Air in Ships, and this notwithſtanding they have the Advantage of Plenty of very pure Air to breathe in, whenever they come upon the open Deck. Theſe daily Inſtances fully prove the great Importance of refreſhing the foul Air in Priſons, Ships, *&c.*

265. DR. *Pringle*, in his ingenious *Obſervations of the Nature and Cure of Hoſpital and Goal Fevers*, ſays, 'That there is no Se-'curity from the Diſtemper at Trials, tho' 'none of the Priſoners are actually ill of the 'Diſtemper; for, beſides that it may be in 'the Blood for ſome Time, without any ap-'parent Symptoms; even in an healthful 'State, the Danger is little leſs, from the 'Cloaths.' Which he propoſes to have burnt.

266. By Order of the Right Hon. *Henry Fox*, Eſq; Secretary at War, Ventilators are fixed under a Guard-bed in the *Savoy*, whoſe Midriffs are eight Feet long, and five Feet broad; with theſe, five Rooms are ventilated; three always, and ſometimes four at a Time. The Air-Pipes draw Air from under the Guard-beds; Grate-work Paſſages being made thro' the Fore-front of the Beds, at

an oblique diſtant Poſition from the Mouth of the Pipes, thereby to prevent the Indraft of any Thing the Soldiers may out of Diverſion put there. And, for the ſame Reaſon, one of the Air-Pipes which goes down thro' the Boards of the Floor to a Room below, does not go directly thro' the Cieling, which is opened at about two Yards Diſtance from the Air-Pipe.

267. MR. *Hayward*, Maſter of the *Savoy* Priſon, has always been very careful to have the Wards ſcraped and ſwept every Morning; for he obſerves that the Dirt of their Shoes much increaſes the Stench and Foulneſs of the Air. Yet, notwithſtanding this his Care to keep the Rooms clean, when there were many Priſoners, they were apt to be ſickly, and to get the Goal-Diſtemper, for want of changing the foul, ſtagnant, putrid Air. The doing of which, by means of Ventilators, has made thoſe Wards ſo healthy, that in the Year 1749, of 200 Men but one died, and he of the Small-Pox. And in the Year 1750, of 240 which were there three Months, but two died. In the Year 1751, none died: And, in the Year 1752, only one old Perſon died. Whereas, before the Ventilators were

put up, there often died 50 or 100 of the infectious Goal-Diſtemper. And this, notwithſtanding they have a paved open Court to walk in, which was waſhed thrice a Week in the Evening, and the Wards as often in the Morning in warm Weather, and every 14 or 20 Days in cold damp Weather. But, before Ventilation, the foul Air of the Wards, which became putrid by long Continuance, being not frequently changed for freſh Air, was infectious and deadly. This probably occaſioned the Goal-Diſtemper there in the Year 1757; one of the large Wards having no Ventilation, whence the Infection might ſpread. And what contributes the more to the preſent Healthineſs of the Place, is, that Mr. *Hayward*, the Maſter of the Priſon, continues with the ſame Care and Zeal to keep it clean. And, the more effectually to cure the Wards of any Infection, he burns, as I deſired him, every ſix Weeks, two Pounds of Brimſtone in the larger Wards, and a Pound in the ſmaller Wards. And Mr. *Akerman*, the Keeper, informed me that the Wards in *Newgate* are cleaned every Week; a laudable Example that ought to be practiſed in Goals; but one of the Wards having no Ventilators, and the Place being crowded with Men, the

Goal-Diſtemper was bred in the very hot Summer of the Year 1757, which was prevented from ſpreading, by removing the Sick, and purifying the Wards with the Fumes of burning Brimſtone and Vinegar. If ſome Trunks were put up for the foul, hot, light Air, to paſs off thro' the Roof, it would probably be an effectual Means to prevent that peſtilential deſtructive Diſtemper from Breeding.

268. VENTILATORS were fixed in *Newgate*, by Order of Sir *Richard Hoare* when Lord-Mayor, which ventilated five principal Wards where the Women were. It was obſervable that the Priſoners were more healthy, and conſiderably fewer of them died, for a Year, during which thoſe Wards were ventilated; which are but Part of the Apartments, in which there are often a great Number of Priſoners. And the greateſt Part of thoſe died, when many ſickly Priſoners were brought from other Goals to *Newgate*, to attend the Seſſions.

269. BUT as this ſalutary Ventilation, in *Newgate*, with Mens Hands, was afterwards neglected, in the Year 1752, in the Mayor-

alty of Mr. Alderman *Winterbottom*, the Lord-Mayor and Aldermen came to a Reſolution to have much larger Ventilators fixed in *Newgate*, to be worked by a Wind-mill. An Affair which I had much at Heart, as being a laudable Example, not only to the reſt of the Nation, but alſo to other Nations, particularly *France*, where the Duke *de Noailles* deſired me, by his Librarian Monſ. *Mazeas*, of the Society of *Navarre*, and F. R. S. to ſend him an Account how it was done; that as far as in him lay, he might promote the having the ſame done in the Priſons of *France*.

270. *h h*, (*Fig.* 19.) the Midriffs of the Ventilators are each nine Feet long, and four and a half wide. Two Pair of theſe Ventilators are laid on each other, (as in *Fig.* 13.) *a b c d*. The Midriffs of both Ventilators are moved up and down by the flat Iron Rods *e f*, which have a Joint at *f*, where they are fixed to the Midriffs, then paſſing thro' the upper Part of the lower Ventilator, and thro' the Bottom of the upper Ventilator, and alſo thro' an Iron Plate at *z*, about three Inches ſquare; this Plate to be covered by another broader Iron Plate, which is to be

ſcrewed faſt to the Bottom of the upper Ventilator: This upper Plate has a wide Hole in its Middle, to give room for the Iron Rod at *g* to move ſideways to and fro, with the under Plate, the Hole of which exactly fits the Iron Rod, by which means no Air can eſcape at *g*; and the like Plates are at *i*, which is the Top of the Ventilator: At *f g*, are Joints, where the Iron Rods are fixed to the Midriffs; by this means both Midriffs are moved up and down at the ſame Time. And the Iron Rods of both Sides of the Ventilators being fixed to one common Lever at *e e*, all the four Midriffs are thereby alternately worked up and down at the ſame Time.

270. THE circular Ends of the Ventilators, as well as all other Parts, are faſtened with Wood Screws dawbed with Greaſe to prevent their ruſting in the Wood, ſo that any Part can be taken off commodiouſly, to rectify any Failure in them.

271. *v v v v x x x x* are the Valve-holes, which are 23 Inches long, and ſix and a half Inches wide. The Valves are covered with Buckram glued on them, for their greater Strength; and if ſome Linſeed-oil is mixed

with the Glue, it will prevent its ſoftening with moiſt Air. The Valves move on Liſts of tann'd Sheepſkin, and fall on Liſts of woollen Cloth nailed round the Valve-holes, to break the Force of their Fall, and better to prevent the Eſcape of the Air.

272. A VERY large Noſe, (*Fig*. 20.) is fixed with Iron Hooks *k k* to the Ventilators *l l*, which Noſe is divided into three Spaces. The middle or largeſt of theſe Spaces, *m m*, receives all the foul Air which is blown into it, from the eight middle Valves *x x x x*, (*Fig*. 19.) whence it paſſes through a Trunk *t t*, ſixteen Inches wide, up through the Leads of *Newgate*, into the open Air. The Top of this Trunk is covered with Weather-boards to keep the Rain out; the middle Valves *x x x x* hang ſo as to open outwards.

273. THE two other outer Spaces or Partitions of the Noſe *p p*, receive the foul Air, which is drawn into them, from the ſeveral Wards, through the Trunks *p p*, and paſſes off into the Ventilators, through the eight outer Valve-holes, *v v v v*, (*Fig*. 19.) whoſe Valves are hung ſo as to open inwards.

274. As the ſeveral branching Trunks are to be opened and ſhut, as it ſhall be found proper to ventilate or not ventilate the ſeveral Wards in their Turns; ſo, in order to prevent the Spoiling the Midriffs of the Ventilators, for want of Supply of Air, when all the Trunks may happen to be cloſed, it was therefore requiſite to have two Holes cut in the outer Noſtrils or Partitions of the Noſe, at *z z*, (*Fig.* 20.) each Hole to be 18 Inches long, and 10 Inches broad or high, and 12 Inches deep, and to have theſe Holes covered with Boxes, 20 Inches long, and 14 Inches wide, to be faſtened with ſliding Fillets like Drawers. The Bottom of each of theſe Boxes to be a large moveable Valve, opening upwards, and towards the Ventilators. Theſe may be called ſniffling Valves, becauſe they are to be made of ſuch a Weight, as to open only when all the Trunks to the ſeveral Wards are ſhut; whereby the Ventilators will always be ſupplied with Air, ſo as not to endanger the Breaking the Midriffs for want of it.

275. And in order the better to ſtrengthen the head croſs Rail of the Midriffs, that they may not be broken by the quick Jerks of the Crank of the Windmill, when it turns faſt,

a ſtrong iron Plate is fixed to that Rail, and for the ſame Reaſon the Iron Axle-tree at the other Hinge-end of the Midriffs is fix'd with Clams or Claws to the Ends of the long Rail.

276. THE Lever which moves the Midriffs up and down is ſtrong, and fourteen Feet long, that the Ventilators may the more eaſily be worked by Men, if needful in long calm Weather.

277. A Weight equal to the Weight of the Iron Rod, which reaches from the Crank of the Mill's Axle-tree, down to one Arm of the Lever of the Ventilators, is fixed on the oppoſite Arm, thereby to take off the Reſiſtance of the Weight of that Iron Rod to the Motion of the Mill.

278. THE Ventilators are about 18 Inches deep in the Clear, thereby to allow for the Thickneſs of the Midriffs; and that they may not ſtrike againſt the Top and Bottom of the Ventilators, which would ſpoil them.

279. THESE Ventilators are fixed in an upper Room of *Newgate*, in order to be near the Windmill on the Leads, which works them. From each of the outer Noſtrils there goes a Trunk, which are 12 Inches in the Clear within-ſide; theſe Trunks paſs along on each Side of the open Area over the Gate-way, but at ſome Diſtance from the Sides of the Area. And then deſcend through all the Floors as far as a little below the Cieling of the Ground-Rooms; and are covered with plate Iron within the Reach of the Priſoners.

280. FROM theſe deſcending Trunks, leſſer Trunks, ſix Inches ſquare within, branch off near the Cieling of every Room. Theſe branching Trunks may be larger or ſmaller, according to the different Sizes of the Wards, and alſo in proportion to the greater or leſſer Numbers of Priſoners that are uſually there.

281. THESE branching Trunks are to extend more or leſs into the ſeveral Wards, in ſuch manner, that when the foul Air is drawn out of any Ward, the freſh Air may enter on the oppoſite Side; and by that means drive all the foul Air out before it. And in caſe

there are ſeveral Inlets for freſh Air on oppoſite Sides of the ſame Ward, then the Trunk reaches to the Middle of the Cieling of ſuch Ward.

282. And that many Wards may be ventilated at the ſame Time, there are ſliding Shutters with long Handles, which ſlide up and down in Staples; in order not only to ventilate ſeveral Wards at a Time, by partly cloſing the ſide Trunks; but alſo wholly to ſhut up the Trunks of ſome Wards, while others are ventilating. The Handles of theſe Sliders are locked faſt, that it may not be in the Power of the Priſoners to ſhut or open them. In order to find out in what Proportion to cloſe with ſliding Shutters the Trunks of the ſeveral Wards that are to be ventilated at the ſame Time, it will be needful at firſt to tie a lighted Candle at the End of a Pole, and hold it at the Mouths of the Trunks, thereby to make ſome Eſtimate of the Quantity of foul Air that is drawn into the ſeveral Trunks.

283. AND when the upper Floors are ventilating, the Air is hindered from being drawn out of the lower Floors, either by

ſhutting all their Trunks, or by a ſliding Iron, which ſhuts the deſcending Trunk, near the Floor of the loweſt of the Rooms that are ventilated. But when the Wards of the lower Floors are to be ventilated, then all the Side-branching Trunks of the upper Floors are to be ſhut, that the whole Effect of Ventilation may be in the Wards of the lower Floors.

284. By this means, all the Wards may be ventilated in their Turns, in ſuch Proportion as ſhall by Experience be found moſt convenient.

285. All theſe ſliding Shutters have large Figures, *viz.* 1, 2, 3, *&c.* painted on them; that by theſe Numbers they may more eaſily be deſcribed, and referred to, in the ſeveral Directions for ventilating the ſeveral Wards.

286. In the Caſe of a Priſon that is built with an open Area or Court in the Middle; the Side of the Priſon which is oppoſite to the Side where the Ventilators are, may commodiouſly be ventilated in its Turn, by having a round brick Air-gutter under-ground,

through which the foul Air of thoſe Wards may eaſily be drawn.

287. In leſſer Priſons the Ventilators need be but one half of theſe in *Newgate*, which may eaſily be worked by men; as is found by Experience in ſeveral Priſons and Hoſpitals.

A Deſcription of the Windmill, which is fixed on Newgate *to work the Ventilators*; Plate IV. Fig. 21.

288. As this Mill is deſigned and contrived to move with a ſmall Degree of Wind, and withal to obtain a ſufficient Power in a ſmall Compaſs, I thought it requiſite to give a Draught and Deſcription of it. *Fig.* 21. *c.* is one of the Croſs-trees which ſupport the Mill-poſt *d*, and the Spurs or Braces *e e*; which Croſs-trees reſt on the Blocks *a*, where they are fixed to the Floor they ſtand on, by ſtrong Iron Bolts, ſcrewed faſt under the Floor. *b*, the Crown-tree, to ſteady the Iron Rod that paſſes there through Braſs Collars, which are contrived ſo as to ſcrew cloſer together as they wear away. *d* is the main oaken Poſt, which is bored hollow for the

Iron Rod *b* to paſs through from the Crank of the Iron Axle-tree *i*. *f* is the Girdle on which the turning Frame *g n* moves; on this Girdle lies a broad circular Iron Plate, on which the Braſs Friction-wheels have their Bearing, and theſe Wheels are ſo placed at different Diſtances as to turn on different Parts of the Plate, and thereby ſave its wearing all in one Circle. Theſe Wheels are three Quarters of an Inch thick, and five and half Inches in Diameter; their Iron Axle-trees are an Inch thick, and move in Braſs Collars. *g*, *n*, is the turning Frame which carries the Axle-tree *i i*, and the Sails *l k*, which are turned ſo as always to face the Wind, by the Vane *h*. *q r*, the double pricked Lines, are Iron Braces, which are faſtened at each End with Iron ſcrew Bolts to keep the Frame from wracking. *z* is the Crank, which is ſix and half Inches long, and therefore gives a Stroke of thirteen Inches: but the lower End of the Iron Rod *x* is fixed to the Lever of the Ventilator, *Fig*. 19. at ſuch a Diſtance from the Centre of its Motion, as to raiſe and fall the Midriffs fifteen Inches; there are Braſs Collars at the Joining of the Iron Rod to the Crank, and alſo at the Bearings of the Axle-tree, which Collars are ſcrewed nearer and nearer as they wear away. The Iron Axle-tree extends forward about two Feet and half beyond the Face of the Sails, from the Extremity of which, *s*, eight Iron Braces *l l*, go to each Arm, to which they are faſtened by Iron ſcrew Bolts, which bind them and the Iron Circle of pricked Lines *m m*, in *Fig*. 22. faſt together; the Diameter of this Iron Circle is ſix Feet. The Sweeps or Arms of the Mill *k k* are ſeven Feet three Inches long. They are morticed into the Knave or Drum *y y*. And as an Angle of 55 Degrees is found, both by mathematical Calculations and by Experience, with a ſmall Windmill placed before the Noſe of my Ventilators, to be the Degree of Weathering, as Millwrights call it, or the Angle or oblique Poſition of the Sail to the Wind, for obtaining the greater Force, ſo an Angle near that, *viz.* of 60 Degrees, has been found by Experience of the right honourable the Earl of *Northumberland*, as he informed me, to do very well in ſuch ſmall Mills. But in common Mills, with very long Arms, the Obliquity of the Sails ought to be leſs; elſe their great Velocity will, in ſtrong Winds, cauſe a counteracting Force at the Back of the Sails. In order to avoid this Inconvenience Mr. *Cowper* very rightly propoſed, not to fill up the whole

Space with Sails, but to leave a void Space of about ſix Inches Breadth between the Sails, as is repreſented in the Sails *m m*, *Fig.* 22. that the direct Current of the Wind, as it paſſed through there, might carry along with it, and give a Turn to the Courſe of the Wind, which elſe, being drove obliquely from the Face of the preceding Sail, would thereby be drove to act on the Back of the following Sail, and thereby abate the Force and retard the Motion of the Mill.

289. *n (Fig.* 21.) is the Brake-pole; and the ſingle pricked Line *t* at the End of it, is the Sword which is to claſp round the Nave to ſtop the Mill, by pulling the Rope *w* which is expreſſed by the ſcroll Line. *o o* is the Bottom Shere-tree of the Turning-frame. *p* expreſſes the Manner of ſcrewing the Braſs Collars of the Axle-tree nearer and nearer as they wear away.

290. MR. BAILY has contrived to prevent a Corn Mill from going too faſt, and more equably, by a fixed Sail, like an Apron, faſtened in Front under the Axle-tree, and acting on a Lever of great Purchace, ſo as to preſs on the Friction-wheel, by a ſmall Roller

greaſed, in proportion to the Strength of the Wind.

291. THE Noxiouſneſs of the putrid Air in unventilated Goals, may be ſeen in the following Account, which was drawn up by Dr. *Pringle*, viz.

An Account of ſeveral Perſons ſeized with the Goal Fever, by working in Newgate, *and of the Manner by which the Infection was communicated to one entire Family.*

292. HAVING lately had an Opportunity of ſeeing ſeveral Caſes of the true Goal Fever ariſing from the Goal itſelf, I thought it would not be improper to lay before the *Society* a ſhort Account of the Manner in which thoſe Perſons were ſeized; the chief Symptoms and Progreſs of the Diſeaſe, with ſome Remarks upon it, in order further to illuſtrate what I have advanced * elſewhere, concerning the Danger ariſing from foul Air, and the Agreement of this Diſtemper with what has been called the Fever of the Hoſpital, or more generally, a malignant or peſtilential Fever.

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* Obſervations on the Diſeaſes of the Army.

293. In the Month of *October* 1750, a Committee of the Court of Aldermen was appointed to enquire into the beſt Means for procuring in *Newgate* ſuch a Purity of Air, as might prevent the Riſe of thoſe infectious Diſtempers, which not only had been deſtructive to the Priſoners themſelves, but dangerous to others, who had any Communication with them, and particularly to the Courts of Juſtice upon the Trial of Malefactors, whereof a fatal Inſtance had occurred that Year at the Seſſions held in the *Old-Bailey*.

294. The Rev. Dr. *Hales* and I being conſulted by the Committee upon the Point referred to them, and having viſited the Goal in Company with thoſe Gentlemen, it was then agreed that, conſidering the Smalneſs of the Place, in proportion to the Number of the Priſoners, it would be proper to make a farther Trial of the Ventilator, and to have it worked by a Machine in the Manner of a Windmill, to be erected for that Purpoſe upon the Leads of *Newgate*.

295. The Scheme was laid before the Court of Aldermen and approved of, but not

put in Execution till near two Years after. For on the 11th of *July* 1752, Dr. *Hales* acquainted Dr. *Knight* and me, that ſeveral of the Tubes were finiſhed, and that the Machine had been going about ſix Weeks; wherefore being deſirous to ſee the Effects, he had appointed Mr. *Stibbs*, the Carpenter employed in that Work, to meet him at *Newgate*, and deſired us to go along with him.— We went accordingly, and having viſited ſeveral of the Wards, we were all of us very ſenſible, that ſuch as were provided with ventilating Tubes, were much leſs offenſive than the reſt that wanted them; and Dr. *Hales* and I could perceive a conſiderable Improvement made upon the Air of the whole Goal ſince the Time we had been firſt there with the Committee. Some of the Wards were ſo free from any Smell peculiar to ſuch Places, that I am perſuaded, were Dr. *Hales*'s Deſign compleated, and a Perſon appointed to regulate the Sliders of the Tubes, and to keep the Machine in order, the uſual bad Conſequences from foul and crowded Goals, might in a great meaſure, if not wholly, be prevented in that Place.

296 ONE of the Wards allotted for the Women, had a ſmall Room adjoining to it, in which they uſually ſlept. Both Places ſeemed at that Time well aired, though the latter was cloſe, and, if I miſtake not, without either Window or Chimney. The Priſoners informed us, that before this Ward received the Tubes, this ſleeping Place had been very offenſive, but that ſoon after it became ſweet; and though upon the firſt Working of the Ventilator they had been more ſickly than before, they ſoon recovered their Health, and had preſerved it ever ſince. Now from this Account we muſt not infer that any Danger will ariſe from a ſudden Change of bad Air for good, ſince this Accident may be better accounted for, from another Circumſtance we were then likewiſe told of, *viz.* that this Ward of the Women had been ſupply'd by a ventilating Tube before thoſe in the lower Story, where the Air being in a more corrupted State, it had paſſed from thence through the Seams of the Floor, and other Paſſages, to replace that which was drawn off by the Tube in the Ward above: but that after the bad Air was exhauſted, the Benefit of the freſh Air ſoon appeared by the better Health of the Priſoners.

297. BUT as it was not my Deſign in this Paper to ſet forth all the Advantages that may be expected from the Ventilator, I ſhall leave that Subject to be treated of by the Inventor of it, and ſhall only take notice, that the Tubes from the ſeveral Wards, uniting in one great Trunk, convey all the putrid Steams by that Channel into the Atmoſphere, through a Vent made in the Leads of *Newgate*.—Though the Wind was moderate during the Time we ſtaid, yet we obſerved that the Ventilator threw out a conſiderable Stream of Air of a moſt offenſive Smell.

298. BEFORE we parted, Mr. *Stibbs* informed us, that *Clayton Hand*, one of his Journeymen, whilſt he was employed in ſetting up the Tubes, was ſeized with a Fever, and carried to St. *Thomas*'s Hoſpital, after lying ſome Days ill at his own Houſe; whereupon apprehending that this Man's Sickneſs might be owing to the Air of the Goal, and Dr. *Knight* and I having the Curioſity a few Days after to go to St. *Thomas*'s to make the Enquiry, we found the Patient ſitting in one of the Courts, recovered of his Fever, though ſtill weak, and had the following Account from himſelf.

299. He ſaid, that upon firſt finding himſelf indiſpoſed, he had left off Work for ſome Days, but upon growing better he had returned to *Newgate*. That ſoon after happening to open one of the Tubes of the old Ventilator, which had ſtood there for three or four Years, ſuch an offenſive Smell iſſued from it, that being immediately ſeized with a *Nauſea* and ſickneſs at his Stomach, he was obliged to go home, and that the Night after he fell into a Fever, in which he lay about eight Days before his Friends carried him to the Hoſpital. That becoming ſoon delirious, he recollected no other Symptom ſucceeding thoſe mentioned, beſides frequent *retchings* to vomit, a trembling of his Hands, and a conſtant Pain in his Head. This Man had taken no Medicine before he came into St. *Thomas's*, and ſince that Time was attended by Dr. *Reeves*; but as that Gentleman was not then preſent, we were informed by the Apothecary, that *Clayton Hand* had been admitted in the advanced State of a continued Fever, attended with a great *Stupor* and a ſunk Pulſe, and that the Fever had not left him till ſeveral Days after his Admiſſion.— The Nurſes Account was, that he had all along lain like one ſtupified, and that after

the Fever went off, he had continued for ſome time very dull of Hearing. We could learn nothing certain about the Duration of the Fever, but from what the Patient and his Attendants told us, we collected that he muſt have been ill between two and three Weeks. So that from all theſe Marks we made little Doubt but this Perſon had been ill of the true Goal Diſtemper, and were confirmed in our Opinion by the following Circumſtance.

300. IN Company with the Convaleſcent was one *Thomas Wilmot*, another of Mr. *Stibbs*'s Journeymen, who had likewiſe worked in *Newgate*, and whom we remember'd a few Days before to have ſeen in that Place, very active and in perfect Health. This Man told us, he had come to ſee his Companion, but as he apprehended himſelf in Danger of falling into the ſame Fever, he ſhould therefore be glad of our Advice. Upon Examination we found his Tongue white, his Pulſe quick, and that he complain'd of a Pain and Confuſion of his Head, with a Shaking of his Hands, and a Weakneſs of his Limbs. He ſaid his Diſorder had come on gradually ſince the Time we ſaw him in *Newgate*, but

that he was then ſo very ill he could work no longer. From which Account it appear'd to us, that this Man had alſo catched the Infection, but as the Fever ſeem'd not to be quite formed, we had hopes of ſtopping its Progreſs: and with this View we adviſed him to take a Vomit, and on the following Night a Sudorific. He followed the Preſcription, and the Effects ſhall afterwards be mentioned.

301. AFTER *Wilmot* had told us his own Caſe, he informed us of the Indiſpoſition of three more of his Companions, who had all been employed by Mr. *Stibbs* in *Newgate*: Whereupon we took their Directions, viſited them, and found them all ill of the Goal Diſtemper.

302. THE firſt was *Michael Sewel*, who lodged in the *Swan-Yard*, near *Newgate*. This Man had been ten Days confined to his Bed, without taking any Medicine. He was then delirious, and had the petechial Eruption. But obſerving that he lay in a cloſe ill-aired and dirty Room, without any Attendants but his Wife, then ſuckling a Child, we believed he had no chance to recover where he was,

and

and therefore recommended his Caſe to Mr. *Stibbs*, who procured his Admiſſion that Day into St. *Thomas*'s Hoſpital, where he alſo recovered.

303. THE ſecond was *Adam Chaddocks*, who lay at a Green-ſhop in the *Little Old Baily*. He was taken ill on the ſame Day with the former, and had uſed no Medicine. He had likewiſe the petechial Spots upon his Breaſt and Back, and though he was not altogether inſenſible, was affected with a *Stupor*, attended with a ſunk Pulſe, and other Symptoms of the Diſtemper. His Landlady, who took care of him, informed us, he had been troubled with *Reachings* to vomit, and a Head-ach from the Beginning, and that for ſome Days paſt, he had been ſeized with a Looſeneſs, and that his Stools were very offenſive. As the Room this Perſon lay in was large and well air'd, we did not think it neceſſary to remove him, but recommended him to the Care of Dr. *Pate*, Phyſician of St. *Bartholomew*'s Hoſpital, who attended him till he recovered.

304. THE third was *John Dobie*, Apprentice to Mr. *Stibbs*, and about 15 Years

old, who lived with his Parents in a Court by the *White Bear* in *Cannon-ſtreet.* We ſaw him on the ſame Day with the other two, which was the 14th of his Sickneſs, and the 12th ſince he took to his Bed. His Mother told us, that ſome of the Journeymen working in *Newgate* had forced him to go down into the great Trunk of the Ventilator, in order to bring up a Wig one of them had thrown into it; and that as the Machine was then working, he had almoſt died of the Stink before they could get him up. That upon coming home, he complained of a violent Head-ach, a great Diſorder at his Stomach, with Reachings to vomit, which had never entirely left him. We found him extremely low, with a ſunk Pulſe, a Dilirium, and an unuſual *Anxiety* or Oppreſſion about his Breaſt. This laſt Symptom we aſcribed to the Opiates he was then taking for a Looſeneſs that had come on two or three Days before we ſaw him. This Lad being in no Condition to be moved, and being beſides well attended by his Mother, and in a well aired Chamber, we preſcribed to him there, and repeated our Viſits till he was quite free of the Fever. It was obſervable, that before he was taken ill he had been twice let down into the great Trunk of the Ventilator, when the Machine was ſtanding ſtill, without complaining of any ill Smell, or receiving any Hurt thereby, but that the laſt Time, when the Machine was working, he immediately cried out, he was ready to be ſuffocated, and the two Men who helped him out, by receiving the foul Steam from the Trunk, were both ſet a vomiting ſo violently as to bring up Blood.

305. ON the 23d of *Auguſt*, *Thomas Wilmot* above-mentioned, called upon Dr. *Knight*, and told him, that after taking the Vomit and Sweats, he had immediately recovered, but begged him to ſee his Wife, who then lay ill of a Fever at his Houſe in *Snow*'s-*fields*, *Southwark*. The Doctor ſuſpecting that this Woman's Indiſpoſition might be owing to the Contagion received from her Huſband, acquainted me with it, and carried me to ſee her. There we were informed that *Wilmot*'s Daughter, a Girl of eight Years old, who lay with her Parents, had been ſeized with a Fever ſoon after her Father's Recovery; that ſhe had been ill about a Fortnight, and they believed had Spots upon her Breaſt, but that ſhe had recover'd without any Medicine.

That her Mother had not only nurſed her, but continued to lie with her, and that ſome time after the Girl's Recovery, the Mother began to complain, and ſoon after fell into a Fever, and that it was the 12th Day ſince ſhe was confined to her Bed. This Woman having the *Petechiæ*, a Stupor with Deafneſs, and a ſunk Pulſe, there was no Doubt of her being likewiſe infected with the Diſtemper, and probably by her Daughter. As ſhe had been without any Aſſiſtance, we adviſed her Huſband to ſend for Mr. *Breach*, Apothecary in the *Borough*, who having ſerved in the Hoſpital of the Army, during the War, was well acquainted with the Nature of ſuch Fevers; and having left Directions with him, we did not return till after the Criſis, which happen'd upon the 16th or 17th Day from the Time ſhe was confin'd to her Bed.

306. Some time after this Mr. *Breach* the Apothecary informed us. that he was again employed in *Thomas Wilmot*'s Family, for that *Elizabeth Marſhall*, his Siſter-in-law, after nurſing his Wife, was taken ill of the ſame kind of Fever, and deſired our Aſſiſtance. This Perſon we found in the ſame Bed, and in the ſame Condition in which we

had ſeen her Siſter ſome time before; and in the Room with her, in another Bed, a Son of *Wilmot*'s, a Boy of nine Years old, ill of the ſame Diſtemper. The former had been attack'd on the 15th of *September*, and the latter the Day before. The Woman's Fever ran out the ordinary length of ſixteen or ſeventeen Days, but the Boy's came ſome Days ſooner to a *Criſis*, and was all along of a milder Nature. She recovered very ſlowly, complaining of great Weakneſs, Deafneſs, and a Confuſion in her Head, the ordinary Conſequences of theſe malignant Fevers.

307. IN my Return I called at St. *Thomas*'s Hoſpital to enquire for one *William Thompſon*, a Lad of about ſixteen Years of Age, who as *Wilmot* then told me, was another of Mr. *Stibbs*'s Journeymen, and had been taken ill by working in *Newgate*, ſince the three he had mention'd to me before. This Lad was recovered, but not yet diſmiſſed.— He ſaid, that upon finding himſelf growing ill he had left his Work, and kept at home for about a Week, complaining of a Pain in the hinder Part of his Head, and in his Back, of a Trembling of his Hands, and of reſtleſs Nights; that his feveriſh Indiſpoſition increaſing, he

had been obliged to take to his Bed, where he lay about eight Days before he was ſent to the Hoſpital. The Apothecary added, that he had continued about the ſame Number of Days before the Turn of his Fever; that his Pulſe had been extremely low all that time, and that they believed him to be in the utmoſt Danger. He added, that the Wife of *Michael Sewel* (the ſecond Patient they had received of thoſe that had been employed in *Newgate*) ſome Days after her Huſband's Admiſſion, came to ſeek Advice for herſelf, and that her Complaints had been the ſame with *Wilmot*'s, at the Time we ſaw him; he added, that he had given her ſome Medicines, but had heard nothing of her ſince.

308. ON the laſt Day of *December*, Mr. *Breach* informed me, that about a Month ago, he had been called to attend *Thomas Wilmot*, but as he died before he ſaw him, he could give no other Account of his Sickneſs, than as they told him, he had long been in a bad State of Health, and that at laſt he became feveriſh, and went off with a Looſeneſs.

309. In the Beginning of this Month, the Widow apply'd to Dr. *Hales* and me, in order to have the Sufferings of her Family atteſted and laid before the Lord Mayor, in hopes of having ſome Proviſion made for them. Upon which Occaſion we learned, that *Thomas Wilmot*, her Huſband, after taking the Sudorific, ſo far recovered as to work at his Buſineſs, but that though he did not return to *Newgate*, yet his Strength would not permit him to continue at Work above a Day or two at a Time, ſtill complaining of a Head-ach and Pains acroſs his Breaſt, or, as he expreſſed it, about his Heart; of a Feebleneſs of his Limbs, a Shaking of his Hands, and a conſtant Drought. That notwithſtanding theſe Ailments, he went out daily till a Week before he died, when he grew very weak and more feveriſh, had ſometimes profuſe Sweats, and at other times a Looſeneſs, and that both theſe Excretions, and alſo his Breath, were remarkably offenſive. That at laſt he was ſeized with Convulſions, and having three Fits in one Day, he died in the laſt of them. His Wife added, that her youngeſt Son *James*, a Boy of four Years of Age, was after the Father's Deceaſe ſeized with a ſpotted Fever, of the ſame kind with what had prevailed in

the Family, but that he recovered; and that her own Mother, *Eleanor Megget*, who did not live in the Houſe, but came often to ſee them, was alſo taken ill of a Fever without Spots, and died about ten Days after her Huſband. She concluded with telling us, that the Diſtreſs of her Family had been increaſed by their being deprived of all Aſſiſtance from their Neighbours, who having thus ſeen the whole Family, one after another, ſeized with this Fever, were as much afraid to come near them, as if they had been infected with the Plague.

310. THIS is all the Account I believed neceſſary to be laid before the *Society*, ſince a more particular Hiſtory of it, with regard to its Symptoms, Nature, and Cure, would have been but a Repetition of what I have already publiſhed concerning the malignant Fever of the Hoſpital, from which theſe Caſes are in nothing different.

311. It will be proper to add, that beſides theſe ſix Perſons that were taken ill by working in *Newgate*, and whom I ſaw, there was another, as Mr. *Stibbs* has lately informed me, but whom I never viſited. So that, be-

ſides *Wilmot*'s whole Family, and *Sewel's* Wife, who received the Contagion at ſecond-hand, there were ſeven Perſons originally ſeized with the Fever out of eleven only that were employed in the Goal by Mr. *Stibbs*. Now as moſt of theſe ſeven were taken ill within a few Days of one another, and of the ſame kind of Diſtemper, it is not to be doubted but that it was owing to the foul Air of *Newgate*.

312. From all which it appears how requiſite it is that the Publick ſhould take ſuch Meaſures as may prevent the like Accidents ariſing from foul and crowded Goals, or indeed from any Place, wherein a Multitude of People are long cloſely and naſtily kept; and which can never be obtained without a conſtant Change of Air.

313. Nor are Diſtempers of this Sort to be accounted among ſuch rare Occurrences as require no particular Proviſion to be made againſt them, ſince from this very Inſtance it is manifeſt how often Diſaſters of this kind may happen without any notice being taken of them. Had it not been for the Accident of our going at that time to *Newgate*, hearing

of the firſt Man's Illneſs, and ſeeing his Companion with him, all theſe Men might have been ill, and not only the Publick, but moſt of themſelves ignorant of the Cauſe. And as for *Wilmot*'s Family, they might have received the Infection, and even have periſhed by it, without any Perſon being convinced of the Danger ariſing from Goals, or the contagious and malignant Nature of the Fever, excepting a few in the Neighbourhood, which is a remote and obſcure Quarter of the City.

314. UPON a Repreſentation to Mr. Sheriff *Janſſen* concerning the Infection of Priſons, he had the Curioſity to examine Mr. *Elſon*, Bricklayer, whoſe Men were employed in the Repairs of *Bridewell*, in *April* 1750; they found ſuch a Stench in the Work-room and Common-ſewers, that they refuſed to go about the Work without Tobacco and a large Dram; theſe all eſcaped unhurt; but the Carpenters not taking the ſame Precaution, four were infected with the Goal Diſtemper, and two of them died.

315. WHEN Ventilators are worked by hand in Priſons, it may be well to have a

ſmall Wind-mill, with Copper or Braſs Sails fixed at the Mouth of the Trunk on the Top of the Priſon, which may cauſe a Hammer to ſtrike a little Bell, which will not only be of uſe to inform the Goaler, whether the Ventilators are worked as much as they ought to be, but will alſo be of uſe to encourage the Priſoners to work them, when they are amuſed with the Sound of the Bell.

316. IN 1749 Mr. *Yeoman* made a ſingle Ventilator for the Dungeon of *Northampton* Goal; the Midriff ſix by two Feet. He put Ventilators alſo into *Shrewſbury* Goal, and in *Maidſtone*, *Bedford*, and *Aylcſbury* Goals, and St. *George*'s Hoſpital; the four laſt worked by Wind-mills.

317 THE noxious Air from near the Cieling of the Wards, which was blown through the Noſe of the Ventilators at the Top of St. *George*'s Hoſpital, gave Mr. *Yeoman* and one of his Workmen, a ſort of ſtupid Head-ach, and made him ſeveral Times ſick to that degree, that they could not continue working in the Place where the Ventilators are, without ſtopping the Mill: And one of the Governors of the Hoſpital was ſick, by only ſtaying there

a ſhort time, to ſee the ſniffling Valves of the Ventilators, which prevent the Air's being drawn too faſt out of the Wards, when the Wind-mill turns faſt. And the foul Air which aſcended through the Trunk on the Top of *Newgate*, made two Workmen who breathed it, vomit inſtantly to ſuch a degree as to vomit Blood, as they told me.

318. THE Surgeons obſerve, that ſince St. *George*'s Hoſpital was ventilated, they are not ſubject, as before, to ſpreading Ulcers; theſe ſpreading Sores are peculiar to ill-aired Places; ſo that when they occur in Hoſpitals, they are often obliged to ſend ſuch Patients into the Country, where they often get well, by their own Dreſſing, of ſuch Ulcers as in the Hoſpitals uſed to defeat all the Art of the Surgeons. And doubtleſs, in moſt other Diſtempers the Sick will fare the better for having freſh, inſtead of foul putrid Air.

319. THERE are alſo Ventilators in *Durham* Goal, and in an Hoſpital at *Naples*, by means of *Prince Santo Severino*, the *Neapolitan* Ambaſſador here. They have alſo Ventilators in *Saxony*, *Sileſia*, *Peterſburg*, and *Lapland*, for divers Uſes.

An Account of ſeveral Methods uſed to refreſh and cure the noxious Air in the Goals and Hoſpitals, and private Houſe Hoſpitals, for the Priſoners and ſick Sailors and Soldiers at Portſmouth, Goſport, *and* Plymouth; *by which they find great Benefit*; viz.

320. HOLES about ſix or eight Inches wide, are made in the upper Part of the Windows of the Chambers or Wards of the Sick, by taking out ſome Panes of Glaſs, and fixing a Board much broader than the Holes, within-ſide, oppoſite to the Holes, at about the Diſtance of an Inch, more or leſs, according to the Strength, Coldneſs or Warmth of the Wind; by which means the entering Air is ſpread every way ſideways, yet ſo as not to blow directly on, and incommode the Patients. There are alſo Holes ſix or eight Inches diameter, made near the upper Part of the oppoſite Walls of Chambers and Wards; oppoſite to which Holes are placed within-ſide, Boards much broader than the Holes, inclining like a Picture, with their upper Part more diſtant from the Wall than the lower Part. And whereas the Air entering in at one of the Ends of theſe ſloping Boards,

may, eſpecially in ſmall Rooms, blow on and incommode the Patients, that End is ſtuffed with brown Paper or Rags. The ſame alſo is to be done at the Windows, more or leſs, according to the different Temperatures of the Air, or Strength of the Winds. The Size of theſe Inlets of freſh Air to be proportioned to the different Sizes of the Chambers or Wards, in private Houſes, Hoſpitals, or Priſons. There are Ventilators in Port *Cæſar* Goal near *Portſmouth.*

321. FRESH Air may alſo with Safety be let into Chambers of the Sick, by keeping the Door conſtantly open, and yet preventing its incommoding the Patients, in the following Manner, *viz.* by hanging on a Rail, about ſeven Feet high, a Canvas-ſcreen between the Bed and the Door. When a lighted Candle is held where the Bed is, the upright Flame ſhews that there is no Motion of the Air there. But the Flame is much inclined by the Force of the entering Air, when the Candle is held between the Canvas-ſcreen and the Door. But at the ſame time it appear'd, by a Candle held at the upper Part of the open Door-caſe, that the upper lighter foul Air, paſſed out of the

Room, being overpowered or impelled by the heavier cooler Air, which entered at the lower Part of the open Door-caſe; which muſt needs greatly refreſh and purify the Air in the Room. The Poſition or Number of theſe Skreens muſt be diverſified, according to the various Poſitions of the Door to the Bed or Beds; but they muſt by no means reach up to the Cieling.

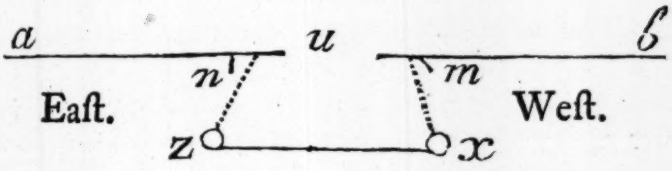
322. And the Door may be fixed at a more or leſs Degree of Openneſs, according to the different Temperature of, or Force with which the Air enters.

323. And in ſuch Wards or Rooms in Priſons as cannot be affected by Doors or Windows, nor oppoſite Holes in Walls, in the remote Corners are fixed ſeveral large Trunks, ſix or eight Inches wide, which go up through the Floors and Roofs of the Priſons, through which the warm foul Air flies with great Velocity.

324. And when the Wind does not blow directly againſt the Wall which we would have it paſs through, a Side-wind may be

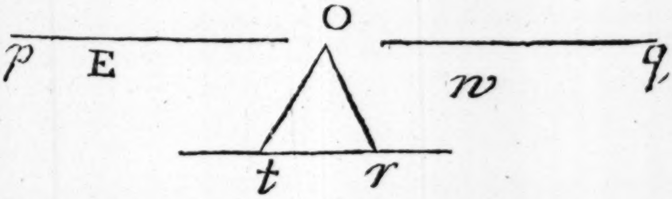
conveyed in, by the following Methods, *viz.*

Fig. 14.



Suppoſing *u* to be a Hole in the Wall *a b*, (*Fig.* 14.) fix on the outſide of it a wide Trunk *x m*, *z n*, with little folding Doors *z n* and *x m*, moving on Hinges *z* and *x*; by which means, when the Wind is in the Eaſt, the Door *z n* opening inwards by the Force of the Wind, will at the ſame time ſhut the Door *m x*, and be conſequently drove through the Hole *u* into the Ward, and *vice verſa* when the Wind is in the Weſt.

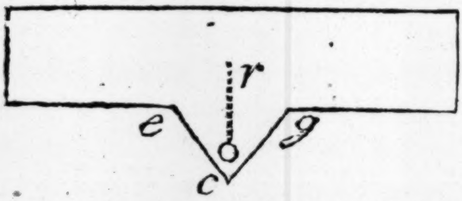
Fig. 15.



Or the Side-winds may be drove into the Hole in the Wall *o*, by a Triangle of Boards *o t r* (*Fig.* 15.) according to Mr. *Tid*'s Contrivance, at his Window Wind-mills. Mr.

Yeoman has made a further Improvement on theſe Methods to turn in Side-winds, *viz.*

Fig. 16.



by having a Door *c r* (*Fig.* 16.) turn on the Hing *c*, ſo as to ſhut againſt *e*, and thereby cloſe up the opening *e c*, when the Wind is in the Weſt; and when the Wind is in the Eaſt to ſhut againſt *g*, and cloſe up the Opening *c g*. And when the Wind blows full againſt the Hole in the Wall *e g*, then the Door will be in Poſition *c r*, and thereby give a free Admittance for the Wind to blow directly in. By this means much Air might be conveyed in at the Stoke-hole of a Malt or Hop-kiln, through a Door-way, or other large Hole in the Wall, oppoſite to the Stoke-hole; and when the Wind is at the Back of the Kiln; then ſhutting the Door oppoſite to the Stoke-hole, the Air which enters through a large Hole in the Wall at the Back of the Kiln, would be drove forcibly in at the Stoke-hole, and thereby dry the Malt or Hops much the ſooner and better, as has been found by Experience. I have been told that Hay-ricks have been the better ſecured from heating and firing, by having not only a Well, as uſual, in the Middle of the Rick, but alſo Side-horizontal Holes through to the Well, to blow away the hot Vapour in the Well.

325. In the upper Garret Wards, at *Haſeler* Hoſpital near *Portſmouth*, which have no oppoſite Windows, Mr. *Yeoman* propoſed the Opening ſmall Apertures in the Cieling, on the Side oppoſite to the Windows. And in ſome Hoſpitals and Goals, to have Trunks ſix Inches wide within, to paſs through the Cieling, to convey the foul Air off, between the Cieling and the Tiles, and in Priſons, up through the Roof, with a turning Vane-cowl on the Top.

326. The Commiſſioners of the ſick and wounded Seamen wrote me word, that they found moſt beneficial good Effects from theſe ſeveral Methods; which were put in practice by the Direction of Mr. *Yeoman*, in the Hoſpitals at *Portſmouth*, *Goſport*, and *Plymouth*.

327. Large Rooms full of Company, and Chambers of the Sick, may be refreſhed, eſpecially in warm Weather; and that with-

out being in the leaſt incommoded by the Warmth of the Fire, in the following Manner, *viz.* Having cauſed a Chimney at the Princeſs of *Wales*'s Houſe at *Kew* to be firſt ſwept, a ſmall common Fire-grate was fixed up the Chimney, with its lower Part a Foot above the Mantle-piece. When there was a Fire kindled in the Grate, the Draught of the Air up the Chimney was more than double of what it was when the Fire-grate ſtood below on the Hearth in the common Way; as was evident, by holding a broad Linen-cloth, from the Mantle over the Face of the whole Chimney, which was by the ſtrong Indraft of the Air blown up to the Fire-grate, as alſo by the greater Indraft of the Air at the opened Door-caſe; as was very ſenſibly to be perceived by a large Linen-cloth ſuſpended over the open Door-caſe; as alſo by the much greater Velocity in the Twirlings of a ſmall Braſs Wind-mill, fixed at a round Hole about ſix Inches diameter, in the upper Part of a Window. Some very reaſonably propoſe the refreſhing the Chambers, or Wards of the Sick, by cauſing Air to paſs through Cloths dipped in Vinegar, or by hanging ſuch Cloths in Chambers of the Sick.

328. Being informed by an experienced Officer, that the Air in Soldiers Tents is very foul and offenſive, eſpecially in wet Weather, the following eaſy and ſafe Means to carry off much of that foul Air, occurred to my Thoughts, *viz.*

329. To cut ſeveral Holes, about three Inches diameter, on both Sides, near the Ridge of a Tent, and ſew to the Ridge, its whole Length, a Piece of Canvas, about two Feet broad, which will lap over a Foot on each Side, and cover the above-mention'd Holes. On the Weather-ſide, the Canvas-lap, or *Weather-valence*, is to be cloſed down; but on the oppoſite Lee-ſide, it muſt be raiſed two, three, or four Inches, more or leſs, according to the Weather, by means of a long ſlender Stick or Lath, fixed to its lower Border or Edge, and with a few ſmall Sticks a Foot long, ſewed to the Valence, and reaching from the Ridge of the Tent to the long Lath, or by ſome other proper Means; which Outlets will doubtleſs greatly refreſh the Air in the Tent, and that without being incommoded with Wind, Dew, or Rain.

330. OTHERS as well as myſelf, have found by repeated Trials, that a Gallon of Air, by being breathed to and fro for a Minute, becomes then ſo very foul, as to be ready to ſuffocate. Hence we may eſtimate, that, by the ſame means, in an Hour ſixty Gallons of Air will be in the ſame Condition; and if five Men are in a Tent, 300 Gallons of Air will be in the ſame Condition; and in eight Hours the foul Vapours of 2400 Gallons, or 45 Tuns, that is, ſix times more Air than the Quantity that a Tent contains, will be thus fouled by the Breath only; beſides the much greater Quantity of rancid Exhalations, which perſpire from the Surface of the Bodies of thoſe Men: And this, beſides the great Quantity of damp Vapours, which in rainy Seaſons wreaks from the wet Canvas of the Tents.

331. SOME Eſtimate may probably be made of the different Degrees of Purity or Impurity of the Air, in ſuch ventilated and unventilated Tents, in rainy Weather, by burning in a Morning, before the Soldiers turn out, ſome of the lower half of a Candle of ſix to the Pound, for half an Hour; which Candle has before been burnt the like time in

a good Air, and put out with an Extinguiſher, to preſerve a good Snuff; the Candle to be weighed to a Grain, both before and after each Trial.

332. WOUNDS will heal better in Tents with a good Air, than when that Air is very foul; for the leſs foul the Air is which we breathe, ſo much the more ſalutary it muſt needs be, not only to thoſe in Health, but alſo to the Sick and Maimed; but eſpecially to the latter, who by reaſon of their Maladies, are much longer confined to their Tents.

333. BUT ſome are of Opinion, that there is no Occaſion for this Precaution in Tents, becauſe the Wind blows through the Canvas, eſpecially when dry, and in ſome degree when wet, as I have found by holding a lighted Candle on the inner Side of the Canvas, when there was a ſtrong Wind: But when there is little or no Wind, it is to be ſuſpected that Tents will be much the more frowzy. Beſides, when much of the damp frowzy Air is continually aſcending out at the Holes, the Air in the Tent will be conſiderably the better to breathe in, and the natural requiſite

Diſcharges of Vapour from the Lungs will be ſo much the leſs checked. And doubtleſs, the leſs the Degree of Dampneſs of the Air in the Tent is, ſo much the wholſomer it will be; for the comparatively ſmall Damp of a new-waſhed Room, is well known to be very unwholſome.

334. THE like Method may probably be uſeful in Barracks, with folding Weather-boards, made to ſhut ſeaſonably, by an eaſy Contrivance by the Wind, or rather by Cowles turning with the Wind, as on Malt-houſes.

335. THERE is propoſed, Numb. 70. Vol. 1ſt, to fume Bale-goods with Safety, which are ſuſpected to be infected with the Plague, by unfolding them in a Ware-houſe, as full of the acid Fumes of burning Brimſtone as Men can live in. And when Men are uſed to them, they will be able to bear a greater Degree of theſe Fumes than others can do, as I found by Experience when I attempted to go into Mr. *Ward*'s Elaboratory at *Twickenham*, where great Quantities of thoſe acid Spirits were made, by burning Brimſtone with heated Pieces of Iron, on

earthen Platters, placed near the Mouths of very large Glaſs Receivers, layed ſide-ways; but I was obliged to retreat immediately: whereas the Women who are uſed to it, continue long in the Elaboratories without being incommoded. I have been informed by a ſkilful Phyſician, that the volatile acid Spirit of Vitriol, diſtilled a ſecond Time from its Colcothar, has been found ſalutary in the Chambers of thoſe who are ſick of the Small-pox, or other putrid Diſtempers.

336. I FIND by the printed authentic Account of the Precautions uſed at *Venice*, which was printed in *Engliſh*, 1752, that they have two very large *Lazaretto's*, where they put great Numbers of Perſons, and large Quantities of Goods, for forty Days, where the Bale-goods of Wool, Cotton, Silk, &c. are chiefly cured of Infection, by opening and expoſing them much to the Air, under Sheds, where they are often handled, and Heaps of them opened and turned over and over again; and the ſame Method was uſed at *Marſeilles*. But I am perſuaded, that if this were done in an Air ſtrongly impregnated with the Fumes of burning Brimſtone, they might be cured of infectious Qualities, both much ſooner, and

more effectually, and with greater Safety to the Perſons. For thoſe acid Fumes are moſt efficacious in deſtroying the putreſcent Quality of the Infection. This Method of fuming Bale-goods will have another good Effect, in preventing Mohair-yarns from being eaten by Moths, which they are apt to be, on being expoſed to the freſh Air in *Lazaretto's:* And would probably be a good Means to preſerve any Goods that are ſubject to be Moth-eaten, to have them at firſt packed up, in ſuch a degree of acid Fumes of burning Brimſtone, as the Packers can bear; or to have thoſe Fumes blown into each Fold, from a Machine proper for that Purpoſe.

337. THE fuming throughly not only the Cloaths ſeparately, but alſo the Perſons of ſuch with only one before fumed Garment on, would probably be of good Uſe; a Practice that has been long uſed in *Turky*, and on the *Mediterranean* Coaſt; by laying them on their Faces, on the Floor of a Room, leſt they ſhould be ſuffocated by the Fumes of the burning Brimſtone, and other aromatic Mixtures which they uſe, and which, inſtead of promoting, rather abate the Efficacy of the Fumes of the principal Thing, Brimſtone, of

which there is but a ſmall Proportion. But this is a very uncertain and imperfect Way of doing the Thing; becauſe the Fumes of burning Brimſtone aſcend principally to the upper Part of the Room, as is well known; and I have found by Experiment. For when thoſe Fumes had aſcended for a conſiderable Time, through a wide Iron Tube, in at a Window, in order to deſtroy Bugs, I could with great Safety, and without being incommoded, walk in the Room: the deadly Fumes reaching in a viſible Cloud, not more than four Feet below the Cieling; though by long continuing the Fumigation, the Room was ſo full of Fumes, as to kill and dry to Powder the Bugs on the Floor. For which Reaſon the Lazaretto Fuming-rooms ought not to be very high roofed.

338. BUT Perſons might bear much ſtronger Degrees of Fumigation than is uſually given them in Lazaretto's, and that with Safety to their Lives, in the following Manner, *viz.* By cutting the Hair off their Heads, and then waſhing the Head with Vinegar, and covering their Eyes, Noſtrils, and Ears with ſeveral Folds of Linen-cloth; one of the Folds to be dipped in melted Wax, which

theſe acid Fumes cannot penetrate; and then fixing their Mouths to ſhort Fawcets or Pipes, only three or four Inches long; which Pipes are fixed in Holes through the Window-ſhutters and Doors, or rather through the boarded Sides of the Rooms, in which the Men are to be fumed. When this Fumigation ſhall be thought ſufficient, then to open the Doors and Windows, giving ſome time for the Rooms to be cleared of the Fumes before the Men venture to take their Mouths from the Fawcets, which will ſoon be done when there is ſome Wind to blow them away. There ought to be a Rail behind the Men, for them to reſt on. As Men would ſtand upright in this Manner of Fumigation, they would be much better expoſed to the Influence of the Fumes than when they lay proſtrate on their Bellies. The Breathing-pipes muſt not be long, becauſe there would be danger of Suffocation, by their own foul Breath: For, if they were ſo long as to contain a Quantity of Air nearly equal to the Quantity of Air which they breathe to and fro, they could then breathe no freſh Air. The Truth of this I found by Experiment, near fifty Years ſince, by cutting aſunder the Wind-pipe of a live Dog, through which Orifice he breathed freely.

ſreely. But when I fixed a Gun-barrel to his Wind-pipe, he was ſoon very uneaſy, and in danger of being ſuffocated, by breathing to and fro the ſame foul Air; but was preſently relieved, on taking away the Gun-barrel.

339. Dr. *Langriſh*, of *Wincheſter*, gave a very ſtrong degree of Fumigation to a Dog, by thus opening his Wind-pipe, and ſtopping the Part next to his Mouth with a Cork; then putting the Dog's Head through a Hole, into a Box, when it was greatly fum'd with the Fumes of burning Brimſtone, without killing the Dog, though it hurt his Eyes.

340. It ſeems probable that Ships may be ſoon, and effectually cured of a peſtilential Infection, in the following Manner; *viz.* By cutting a ſquare or round Hole, about ſix or eight Inches diameter, through the Wind-ward-ſide of a Ship, below the lower Deck, and fixing therein a wide Iron crooked Tube, of the ſame Diameter: The lower End of the Tube to ſtand on a Stove, in which plenty of Brimſtone, with Charcoal, or red-hot Iron, is to be burnt; *viz.* about fifty Pounds

Weight, that the whole Ship may be filled with its acid Fumes. Which will be the more effectually done, if there are two or three ſuch Iron Tubes and Stoves, or Hearths, for the Brimſtone to burn in at the ſame time. The upper Deck, Gratings, *&c.* to be cover'd with Tarpaulins. When the Bales are taken out, to burn in the Ship as much Brimſtone as the Men can bear.

341. The Mens Cloaths ought alſo to be fumed, and then waſhed in ſalt and afterwards freſh Water. The Men alſo to be bathed in, and drink ſome ſalt Water, and to take anti-peſtilential Medicines; ſuch as Mineral Acids, *&c.* And if they are afterwards fumed in a Room, as above-mentioned, (Numb. 338.) theſe will be probable Means, in moſt Caſes, much to ſhorten the Time of performing Quarentine, as well as effectually to cure the peſtilential Infection. Monſ. *Du Hamel de Monceau*, (to whom I ſent this Propoſal) informed me, that theſe Methods of purifying Quarentine Ships, Men and Goods, are now practiſed in the *Mediterranean* Ports of *France*, where they traffick much with *Turky.*

342. It is the Opinion of experienced Navigators of long Voyages, that the Scurvy is occaſioned more by the noxious putrid Air in Ships, in which there are many Perſons, than by the ſalt Fleſh. Many Particles of Fleſh, though carefully cured with Salt, will, in time, grow putrid. Dr. *Addington* told me, that he put a ſmall Piece of ſalted Beef into Water, and at the ſame time, a like Piece of freſh unſalted Beef, into another like Quantity of Water, and found the ſalted Fleſh to ſtink firſt; which ſhews the very near Tendency of it to Putrefaction, though the Salt keeps it from offending the Taſte or Smell. So that ſalted Fleſh as well as putrid Air, has a Tendency to occaſion the Scurvy, as well as other Diſtempers. Hence, no wonder that the living long on very ſalt Fleſh, ſhould contribute to the Muriatick Scurvy, which is frequent among Mariners, not only by its putrid Tendency, but alſo by cauſing an Acrimony of the Serum, and Eroſion of the ſmall Fibres. And in Ships where they are not only crowded with Men, but have alſo between Decks many live Animals, for freſh Proviſions, the Air muſt needs be ſo much the more foul, putrid and unwholſome.

343. THE ſappy Vapour which ariſes from Ships built with green Timber, makes thoſe Ships ſo very unhealthy, that they continue ſo to the laſt of their Duration; this, together with the putreſcent Vapour which ariſes from many human Bodies, and from the ſtinking Bilge-water, muſt needs be very noxious.

344. AND as thoſe great Evils are, by happy Experience, remedied by the good and ſalutary Effects of Ventilators, which are now become in general Eſteem and Uſe in Ships; it will therefore be requiſite to give an Account of them, and of the ſeveral Methods and Places of fixing them in Ships of different Sizes.

345. AS to the Ventilators which are mentioned Numb. 32. to be put on-board the *Captain*, a 70 Gun Ship, in the Year 1742, and alſo, not long after, on-board the *Blandford*, a 20 Gun *Guinea* Slave-trader. Knowing that they were received with Coolneſs by ſome, and with Contempt by others, as is uſual in the Caſe of new Things, I have reaſon to ſuſpect that they were very little uſed, and not with the proper Precautions, ſo

as to make the Ventilation the moſt extenſively beneficial to the greateſt Part of the Ship; which is beſt done, by ſhutting all the Hatches of the lower Deck during the Ventilation, whereby the Air will be more equably drawn from all Parts between Decks, through the Seams of the Cielings: But if the Hatches are open, then the greateſt Part of the Hold, as well as of the Spaces between Decks, will receive little Benefit by Ventilation.

346. VENTILATORS were put on-board the *Laura*, Mr. *Reid*'s Felon-ſhip. And in the Year 1749, in five *Nova-Scotia* Ships, by Order of the Earl of *Halifax*, and the Board of Trade and Plantations; ſeveral of which were fixed on the lower Deck, in the Fore-part of the Ship; which is a good Situation for conveying the foul Air out through the Trunk of the Ventilators, without incommoding thoſe on Deck, which might alſo endanger their Health. In ſome of thoſe Ships, they were fixed under the lower Deck, on one Side of the Well, the foul Air coming above Deck, under the Gang-way. The Midriffs of theſe Ventilators were ſeven Feet ten Inches long, and three Feet ten Inches wide.

347. IN the Year 1751, Mr. *Yeoman*, who now lives in *Little Peter-ſtreet*, *Weſtminſter*, was ſent by the Lords of Trade and Plantations, to *Rotterdam*, to fix Ventilators in four Tranſport-ſhips for *Nova-Scotia*. They were placed in two of them cloſe under the upper Deck, to ſave Bed-room. And they drew the Air out of the Hold, and from between Decks, alternately. For the two other Ships, which had more People, inſtead of double, he was obliged to make two ſingle Ventilators, with Midriffs ſeven Feet long, and three Feet wide. One of them was fixed on one Side of the Fore-maſt, and the other on the other Side of it. They were worked by one common Lever upon Deck, which was fixed cloſe to the Maſts, ſo as eaſily to be removed or unſhipped, as they term it.

348. HE left a Model of a double Pair of Ventilators at *Rotterdam*, and inſtructed a Perſon there how to make them. But notwithſtanding this his Care to put them in a Way to make and fix them in Ships at *Rotterdam*, yet many Ships, with great Numbers of Paſſengers on-board, having neglected to have Ventilators, many of their Paſſengers periſhed by the Ship-ſickneſs; which put

Mr. *Pen,* on propoſing to the Aſſembly at *Penſilvania,* the Making of a Law, to lay a great Penalty on every Ship that has not Ventilators on-board, and do not work them frequently.

349. He alſo fixed two ſingle Pair in Mr. *Cramond*'s Slave-ſhips; their Midriffs ſeven Feet by three. And alſo in a Corn-ſhip, where they were fixed between the main Beams of the upper Deck, one on the ſtarboard, and the other on the larboard Side, with the Valves towards the Sides of the Ship; they were worked by one common Lever in the Steerage.

355. In ſome Tranſport-ſhips he fixed two Ventilators, between Decks, in the Fore-part of the Ship, one on each Side of the Bowſprit. The working Lever was ſuſpended on an Iron Pin fixed in the Fore-maſt. And in order to prevent the wet getting down into the Ventilators, through the Hole in the upper Deck, where the Iron Rod paſſes from the Lever down to the Ventilators, he makes the Iron Rods not to go directly down into the Ventilators, but reach down, and be fixed to the End of Levers placed lengthwiſe under

the Ventilators, parallel to the Midriffs, and reaching beyond the End of the Ventilators: From which Under-lever an Iron Rod reaches up, and is fixed to the Midriffs, to work it up and down; by which means no wet can get into the Ventilators.

351. The Benefit of Ventilators in Tranſport-ſhips, has been found by repeated Experience, to be very great. I was informed that in a *Liverpool* Ship, which had Ventilators, not one of 800 Slaves died, except only a Child, born in the Voyage; but that in ſeveral other Slave-ſhips, without Ventilators, there died 30, 40, 50, or 60 in a Ship. Doubtleſs nothing will contribute more to the Preſervation of the Health of Men in Ships, Hoſpitals, and Priſons, than frequently changing the foul Air, which is apt to putrify when long confined, and then ſoon communicates its infectious deadly Venom to human Bodies. It cannot therefore be inculcated too much, nor repeated too often, that it is the high Degree of Putrefaction (that moſt ſubtile Diſſolvent in Nature) which a foul Air acquires in long ſtagnating, which gives it that peſtilential Quality, which cauſes what is called the Goal Diſtemper. And a very ſmall Quantity,

tity, or even Vapour of this highly attenuated Venom, like the Infection or Inoculation for the Small-pox, ſoon ſpreads its deadly Infection. Ought not Men, therefore, from the common natural Principle of Self-preſervation, to uſe their utmoſt Endeavours to ſhun this mercileſs Deſtroyer?

352. The following Inſtances, as they are ſtrong Proofs of the great Benefit and Uſefulneſs of Ventilators in Ships, ſo they alſo fully prove, that they can moſt commodiouſly be fixed and worked in them, in contradiction to the vulgar, falſe, and groundleſs Notion, that they take up too much Room, and are incommodious, and in a manner impracticable to be worked; whereas the Men are eager to work them; and many more Perſons can be with Safety to their Health and Lives, in a ventilated, than in an unventilated Ship; which fully obviates the Objection, as to the Room they take up. In new and important Reſearches, the likelieſt Way to ſucceed is, to purſue a Thought, not only by imperfect and fallacious Reaſonings, but when the Nature of the Thing requires it, with a proper Series of Trials and Experiments. Thus, in the preſent Caſe, the principal Cauſe of the

Sickneſs in Ships is the noxious putrid Air; the obvious Remedy is, the exchanging that foul Air for freſh, by effectual Means, which are ſeldom diſcovered by dwelling only on Objections; but are uſually the Reward of repeated, diligent, experimental Reſearches. Neither are we to be diſcouraged in theſe our Purſuits by ſome Diſappointments, for I have frequently found that they lead to the Thing ſought for.

353. AND by the like Clue of Reaſoning and Experimenting, there is the greateſt Probability that we ſhall ſucceed in another very important Reſearch, *viz.* the preſerving much longer from Decay the Timbers of Ships laid up in ordinary in Harbour: For as we are aſſured by daily Experience, that the Decay is wholly owing to damp, cloſe, confined, putrid, corroding Vapour and Air; ſo the only Remedy for this Evil, is the frequently changing the Air and Vapour among the Timbers, by plentiful Ventilations; which we find, by happy Experience, can be effected to ſuch a degree, as gives reaſonable Hopes, enough to encourage our further Trials and Reſearches.

354. Captain *Thomſon*, of the *Succeſs* Frigate, in his Letter to me, dated *London*, *Sept.* 29, 1749, ſays, "That during the Ventilation, the Lower-deck Hatches were "commonly kept cloſe ſhut; by which "means the Air was drawn down into the "Hold, from between Decks, through the "Seams of the Cieling, among the Timbers "of the Ship; by which means we found "the foul Air ſoon drawn off from between "Decks. Our Rule for ventilating was for "half an Hour every four Hours; but when "the ventilating was ſometimes neglected "for eight Hours together, then we could "perceive, eſpecially in hot Weather, a very "conſiderable Difference by that ſhort Neglect of it, for it would then take a longer "Time to draw off the foul Air. Our general "Rule was, to work the Ventilators till we "found the Air from them ſweet. We all "agreed that they were of great Service, the "Men being ſo ſenſible of the Benefit of "them, that they required *no driving* to "work that which they received ſo much "Benefit by. We found this good Effect "from Ventilation, that though there were "near 200 Men on-board, for almoſt a Year, "yet I landed them all well in *Georgia*,

"notwithſtanding they were preſſed Men, "and delivered me out of Goals, with Diſtempers upon them. This is what I believe but few Tranſports, or any other "Ships, can brag of; nor did I ever meet "the like Good-luck before; which, next "to *Providence*, I impute to the Benefit received by Ventilators. It is to be remarked, "that we who lay Wind-bound for four "Months, with our Expedition-Fleet, which "ſoon after invaded *France*, were healthy "all the Time, when they were ſickly in all "the Ships of that Expedition. This certainly occaſioned all kind of Grain-proviſions to keep better and longer from "Weevels, than otherwiſe they would have "done. And other kinds of Proviſions received Benefit from the Coolneſs and Freſhneſs of the Air in the Ship, from Ventilation."

335. MR. *Cramond* alſo informed me, that he found the good Effect of Ventilators on-board a Slave-ſhip of his, with 392 Slaves, twelve of which were taken on-board, juſt before they ſailed from *Guinea*, ill of a Flux, which twelve all died; but the reſt, with all

the *Europeans* in the Ship, arrived well at *Buenos Ayres.*

The following is a Letter to me from Captain Ellis, *viz.*

356. "Sir, could any thing increaſe the "Pleaſure I have in literary Intercourſe with "you, it would be, to find that it anſwered "your End in promoting the publick Good. "The *Vis Inertiæ* of Mankind, is not the only "Difficulty you have had to encounter, but their "Ignorance and Prejudices, which are almoſt "inſuperable. It is to your Perſeverance and "Reſolution, that the little Progreſs you have "made is due. Indeed, I ought not to ſay "little, for it is a great Step to have found "the few that have Hearts good enough to "reliſh your Plan, and Heads ſufficiently "clear to diſcern the moſt effectual Method "of advancing it. It does Honour to thoſe "noble, and other Perſonages, that join you "in Acts of ſuch extenſive Humanity, as the "Introduction of Ventilators to Hoſpitals, "Priſons, Ships of War, and Tranſports, *&c.* "as they muſt needs render the Miſeries of "the firſt more ſupportable, and the cloſe "and conſtant Confinement of others leſs

" prejudicial and fatal to their Health and
" Life. It is to be lamented that they are
" not more generally made uſe of; for, not-
" withſtanding their Advantage is apparent
" and inconteſtable, it is ſcarce credible how
" few make uſe of Ventilators among the
" vaſt Numbers of Ships daily employed in
" carrying Paſſengers, Slaves, Cattle, and
" other periſhable Commodities. Thoſe of
" your Invention, which I had, were of ſin-
" gular Service to us; they kept the Inſide
" of the Ship cool, ſweet, dry, and healthy:
" The Number of Slaves I buried was only
" ſix, and not one white Man of our Crew,
" (which was thirty-four) during a Voyage
" of fifteen Months; an Inſtance very un-
" common. The 340 Negroes were very
" ſenſible of the Benefits of a conſtant Ven-
" tilation, and were always diſpleaſed when
" it was omitted: Even the Exerciſe had
" Advantages not to be deſpiſed among
" People ſo much confined. I muſt not,
" however forget, that Ventilation alone is
" inſufficient to keep Diſorders out of Ships;
" for often Infections are brought aboard by
" the Slaves or others; and frequently Diſ-
" eaſes are produced by feeding on bad or
" decayed Food; but oftener ſtill by Inſo-

"briety; for I have ever remarked, that the "immoderate Uſe of ſpirituous Liquors in "warm Climates, is more pernicious and "fatal, even than the Malignancy of the "Air itſelf. In cold Countries too, where "I have had Experience, thoſe Sailors, or "others, who accuſtomed themſelves to hard "drinking, eſpecially of Drams, had the "Scurvy in a terrible degree; whereas thoſe "who were temperate and ſober, either "eſcaped it entirely, or had it but mode"rately. The Effect of Drunkenneſs was "ſtill more diſcernible among the *Indians* "adjoining to our Settlements in *Hudſon*'s "Bay, who are a feeble, diminutive, chilly, "indolent Set of People. On the contrary, "thoſe who come from the inland Parts, "who are not uſed to drink Brandy) are "brave, active, robuſt, and induſtrious. The "ſame Difference is obſervable in the *Afri*"*cans*, and perhaps among the Inhabitants "of moſt other Nations, did we attend to "it. It was to the unuſual Sobriety of my "Crew that I aſcribed, in ſome meaſure, "their uncommon Healthineſs; for Sailors "breathe a purer Air, and enjoy more Exer"ciſe and Liberty, than Paſſengers or Slaves; "wherefore their Ailments are owing to bad

" or diſorderly living, as well as to unwhol-
" ſome Air. Could I but ſee the immoderate
" Uſe of ſpirituous Liquors leſs general, and
" the Benefits of Ventilators more known
" and experienced, I might then hope to ſee
" Mankind better and happier.

I am, *&c.*

Briſtol, Dec. 26, 1753.

HENRY ELLIS.

357. AND by the like good Conduct, in his next Voyage, in the Year 1755, not one of 312 Slaves died; and all his Sailors arrived alive and well at *Briſtol.*

358. DR. *Demainbray*, who has ſhewn Courſes of Experimental Philoſophy to his Royal Highneſs the *Prince* of *Wales*, and *Prince Edward*, in a Letter to me, farther confirms the great Benefit of Ventilators in Ships, *viz.* " That in the Year 1753, Venti-
" lators were put into the Veſſels in the
" Slave-trade, at *Bourdeaux*, and in other
" Ports of *France*; the happy Effect of which
" was, that inſtead of the Loſs of one-fourth
" of thoſe valuable Cargoes, in long Paſſages
" from *Africa* to the *French* Plantations, the
" Loſs ſeldom exceeded a twentieth. And

"ſince my Return to *England*, I have been "informed of a *French* Veſſel, which by this "ſelf-evidently reaſonable Precaution, ſaved "308 out of 312 Slaves, ſpite of moſt tedious "Calms, and a long Paſſage." And Dr. *Garden*, in his Letter to me, dated *Charles-Town*, *South-Carolina*, *March* 24, 1756, ſays, "It is, indeed, very wonderful, that the "Slave Merchants do not come into the Uſe "of Ventilators. There are few Ships come "here from *Africa*, (even though they call "for freſh Proviſions and Water at the "Iſlands) but have had many of their Car-"goes thrown over-board; ſome one-fourth, "ſome one-third, ſome loſe half; and I have "ſeen ſome that have loſt two-thirds of their "Slaves. I have often gone to viſit thoſe "Veſſels on their firſt Arrival, in order to "make a Report of their State of Health to "the Governor and Council, but I never yet "was on-board one, that did not ſmell moſt "offenſive and noiſome; what from Filth, "putrid Air, putrid Dyſenteries, (which is "their common Diſorder) it is a wonder "any eſcape with Life."

359. AND the Earl of *Halifax* has often informed me of the great Benefit they found

by the Uſe of Ventilators, in ſeveral *Nova-Scotia* Tranſport-ſhips, twelve to one more having been found to die in unventilated than in ventilated Ships. And there are many more Inſtances of the ſalutary, good Effects of Ventilators in Ships. It is, indeed, a ſelf-evident Thing, that the changing the foul Air frequently in Ships, in which there are many Perſons, will be a Means of keeping them in better Health, than not doing it; which makes it the more aſtoniſhing, that effectual Propoſals to remedy ſo great an Evil, ſhould for ſo many Years be received with ſo much Coldneſs and Indifference by Mankind.

360. BUT, God be thanked, they are now come into general Eſteem, from the apparent ſalutary good Effects of them in our Fleets, Hoſpitals, &c. In the Beginning of the Year 1756, the Lords Commiſſioners of the Admiralty ordered them to be put on-board the *Royal George*, our largeſt Ship: In which the Honourable Admiral *Boſcawen*, taking care to have them properly worked, they were found to have the deſired good Effect, ſo to refreſh the whole Air in the Ship, as to preſerve in good Health 850 People; which

happy Event occaſioned their being ordered to be put into the whole Fleet. I ſhall, therefore, here give ſome Account of the Manner of fixing and properly working them, ſo as to ventilate all Parts of the Ships; as directed by Mr. *Yeoman*, who was appointed the Contriver and Director of that important Affair.

361. THE following is his Account of his Manner of fixing Ventilators in the Men of War; *viz.*

362. THE Ventilators in large Ships, ſince the Order for ventilating the Fleet, are fixed in the Gunner's Fore-ſtoor-room, and generally a-head of the Sail-room. The foul Air is carried up through the Decks and Forecaſtle, near the Fore-maſt, ſometimes afore it, ſometimes abaft it, but more frequently on its Starboard-ſide; the Lever by which the Ventilators are worked, is under the Forecaſtle in two-deck Ships, and between the upper and middle Decks in Three-deckers: Sometimes the Lever is hung a-thwart Ships; in ſome Ships afore and aft; and in others oblique: No certain Rule can be given becauſe

of the different Conſtruction of the Fore-part of Ships, and working the Gears. The Iron Rod or Spear which communicates the Motion from the Lever, paſſes through the Partners of the Fore-maſt, and is connected with another Lever, which is ſuſpended at or near the Middle; in ſome Ships over the Ventilators, in others under them, when it is found neceſſary to fix them up to the Deck, to ſave Room: The laſt mentioned Lever is a good means to convey the Motion to the Ventilators, becauſe it is not neceſſary that the Lever ſhould be in the ſame Direction with the Ventilators lengthways. The beſt Method to ſave Room is, to place the Ventilators one upon the other, with their circular Ends one over the other; the Weight of the Midriffs are nearly counter-ballanced by the Iron Rod or Spear which comes down from the upper Lever; if it be not quite ſufficient, then ſome Lead may be added at the Spear-end of the Lever. It is very requiſite to have the Air-Trunk ſo high above Deck, that the Men on Deck may not be incommoded by the foul Air which blows out of it. For which reaſon the Trunk comes through the upper Deck, near and behind the Fore-maſt. Captain

Darrel told me, that he had a live Chicken held at the Noſe of the Ventilators of the *Royal George*, where it ſoon ſickened and died.

363. In Frigates from 50 Guns to leſſer Ships, no general Rule can be obſerved in fixing them. Sometimes they are obliged to fix them afore and aft, ſome a-thwart Ships; at other times obliquely. In ſome Ships they are fixed up to the Deck, and the Lever worked under the Ventilators: And in ſome of the ſmaller Ships it is more difficult to fix them; in ſome Ships they are put into the Hold, and in others under the upper Deck.

364. The ſmall ſingle Ventilators (*Fig.* 6.) are uſed to refreſh the Air in the Well and Bread-room. While this is working, the foul Air ought to be drawn out from between Decks, by the great Ventilators.

365. *Sizes of Ventilators,* &c. *to be put on-board of his Majeſty's Ships of War.*

	Guns.	Ft.	Inches.	Ft.	Inches.	Ft.	Inches.		Inches.	
Three Decks.	100	10	0 long.	4	6 broad.	2	0 deep.	Trunk or Pipe	12	ſquare.
	90	Ditto		Ditto		1	10		11 $\frac{1}{2}$	
	80	Ditto		Ditto		1	8		11	
	70	Ditto		Ditto		Ditto			Ditto	
	60	Ditto		Ditto		Ditto			Ditto	
	50	9	0	4	3	1	6		10	
	40	8	6	4	0	Ditto			9 $\frac{1}{2}$	
	20	8	0	Ditto		Ditto			9	

366. *N. B.* In two-deck Ships, which are large and capacious in the Hold and between Decks, carrying a great Number of Men, ſuch as the *Invincible*, *Magnanime*, &c. the Ventilators ought to be as large as thoſe of a 90 Gun Ship.

367. Although the Dimenſions of the Ventilators for 20 Gun Ships are given above, yet as the Conſtruction of thoſe Ships is ſo very various, the Sizes muſt be left to the Diſcretion of the Officers of the Yard; and if Ships of a larger Size, which are already fitted, ſhould be cramped for Room, ſome ſmall Variation from the above Dimenſions may be admitted in particular Inſtances, provided ſuch Variations be not brought into too general a Cuſtom.

368. If the Diſpoſition of the Beams and Carlings be ſuch, that the Trunks or Pipes of Conveyance, cannot be exactly an equal Square, they may be made oblong, or of unequal Sides, provided that the Aperture be of the ſame Area. For Inſtance, if the Trunk ſhould be 12 Inches ſquare, its Area will be 144 ſquare Inches: But its Size may be varied to 18 by 8, which, multiplied together, make 144, the Area required; and ſo of the reſt. It will not be adviſeable to contract them the narrow Way to leſs than ſix Inches.

Rules for ventilating large Ships.

369. A PARTICULAR and conſtant Regard ſhould be had that the Stroke of the Lever, by which the Ventilators are worked, be not made with ſudden Jerks, but long and ſteady, not too quick.

370. WHEN the Hold is to be ventilated from one End to the other, the three Doors of the Gang-way into the Gunner's Store-room, muſt be opened, and all the Gratings on the Gun-deck to be laid with Tarpaulins over them, leaving all Doors open whoſe Rooms want Ventilation, on the Orlop, and the Steward-room Hatch. But when it is thought proper to ventilate between Decks, then the Doors of the Gang-way into the Gunner's Store-room, muſt be ſhut, and the Scuttle in the headmoſt Trunk or Pipe, upon the Gun-deck, muſt be opened, by ſliding up the Board which covers it, and all the Gratings of the middle Deck, (if it be a Three-decker; or of the upper Deck, if it be a two-deck Ship) to be laid with Tarpaulins, and, if poſſible, to open one of the Stern-ports; or, for want of that, the aftermoſt Hatch-way, or a Scuttle on purpoſe, through the Deck,

as near the Stern as may be. The Times of working the Ventilator will beſt be directed by the commanding Officer on-board, according to the State of the Ship, Weather, *&c.* perhaps half an Hour every Watch, or more.

371. I SHALL next mention Inſtances of Sicklineſs and Mortality in Ships which had Ventilators, as a Precaution to avoid, as much as poſſible, the Occaſions of it; *viz.*

372. DR. *Brownrigg*, of *Whitehaven*, wrote me word, " That in two Tranſport-ſhips of " that Town, freighted with Proteſtants at " *Rotterdam*, the Goal Diſtemper broke out " to ſuch a degree, as to occaſion the Death " of 100 out of 160, in each Ship; which " was occaſioned by their neglecting to work " the Ventilators for ſix Weeks, while they " lay there with 50 or 60 Paſſengers on-" board; during which time the Infection " bred among them; for ſoon after the Ships " ſailed, an infectious Fever broke out among " the Paſſengers, and notwithſtanding great " Care was taken to ventilate the Ship every " Day, and though they found ſuch Venti-" lation very refreſhing, as well to the Sound

" as to the Sick (the Air which they pumped " out being horribly fœtid) yet many died " daily, equally among the Sailors as among " the Paſſengers: So that when they arrived " in *Nova-Scotia*, there ſcarce remained Men " ſufficient to navigate the Ships; and thoſe " that did remain were, with great Difficulty, allowed to go on ſhore, for fear of " ſpreading the Infection." So that, as the Doctor juſtly obſerves, " Ventilators in Ships " are to be uſed rather as a Preſervative " againſt the Production of Goal Fevers, " than as a Means of removing the Contagion " of ſuch Diſeaſes; or of curing them, after " they are produced in ſuch confined Places. " The Perſons labouring under theſe malignant Diſorders, continually emit large " Quantities of putrid infectious Exhalations, " which can ſcarce fail of infecting thoſe " who are lodged in the ſame cloſe Places " with the Diſeaſed, even though continual " Ventilation be uſed; Ventilators may, indeed, in ſuch Caſes abate the Malignity of " the Diſtemper, and may contribute to the " Recovery of the Diſeaſed, but cannot intirely prevent the Infection from being " communicated from the Sick to the Sound " confined with them." It has been obſerved,

ſerved, that thoſe Sailors who continue much in their Hammocks, are moſt ſubject to have and die of the putrid Scurvy, which they therefore attributed to their Lazineſs, which may in its degree occaſion it. But it is greatly to be ſuſpected, that a principal Cauſe of it is, their too long continuing in, and breathing the noxious, cloſe, confined, putrid Air in the Ship, whoſe peſtilent Infection has deſtroyed Millions of Mankind.

372. THE Goal Diſtemper broke out in Mr. *Reid*'s Convict Tranſport-ſhip the *Laura*, notwithſtanding the Ship was frequently refreſhed by Ventilation. The Convicts were put on-board the latter End of *April*, in ſeeming good Health, and continued ſo till they anchored in *Stromneſs* Bay, in the *Orcades*, when between the 11th and 15th of *May*, a great Part of the People fell ſick of the Goal Diſtemper, in the compaſs of two Days, which Sickneſs ſeized not only the Convicts, but alſo the Ship's Company, ſo that many of them alſo died of the ſame Diſtemper.

373. IT cannot, therefore, from theſe Inſtances be concluded, that Ventilation is of no Service in preſerving the Health of People

in Ships, becauſe it is reaſonable to believe, that the Convicts in the *Laura* brought the Goal Diſtemper with them from *Newgate*, which they often carry to *Virginia* before it breaks out: For there are many Inſtances of that Diſtemper being carried a great way from Ships and Goals, by Perſons in ſeeming Health. Thus in the great Embarkation of many Thouſands, who attacked and took *Boccacheky* in *America*, I was credibly informed, that many died of the Goal Diſtemper in every Ship which had Sailors out of the great Guard-ſhip, at the Mouth of the *Thames*, in which were great Numbers of preſſed Men.

374. AND Dr. *Pringle*, the Duke's Phyſician, informed me, that a Regiment of Soldiers, having catched the putrid Goal Diſtemper from ſome Perſons in Ships, which carried them in the late Rebellion to *Inverneſs*, about 200 of them died of that Diſtemper at *Inverneſs*. The Remainder of them went in ſeemingly good Health, a-croſs *Scotland* to Fort *William*, where, ſeven Weeks after, the Diſtemper broke out afreſh among them, and killed many of them; whence the Doctor reaſonably infers, that the Seeds of the Di-

ſtemper may lie long latent in the Patient. It is, therefore, very probable that the Convicts brought this Diſtemper with them from *Newgate*; for the Workmen who put the Ventilators at that time into *Newgate*, told me, that the lower Womens Ward was ſo intolerably offenſive, that they were afraid to go into it to do their Work; there being only a ſmall Window at one End for Communication with the outer Air: Whence it is probable that, beſides the near Tendency they might thereby have to be ſeized with the Goal Diſtemper in their Conſtitutions, when they came on-board the *Laura*, they might alſo bring Infection in their Cloaths, which might take ſome Time before it broke out into Sickneſs. It would be well, therefore, in theſe Caſes early to make uſe of inward Applications, in order, if poſſible, to prevent the Breeding of the Diſtemper, from any latent Cauſe or Diſpoſition in the Patient; for it is reaſonable to think, that this Diſtemper is much eaſier to be extinguiſhed by proper Regimen, in this latent Embrio State, than to be cured when it comes to its full Height.

375. AND as Acids are well known to check vegetable Ferment, ſo are they found of uſe to check or reſiſt Putrefaction, which is animal Ferment. And accordingly, Phyſicians, among other Things, preſcribe Spirit of Sea-ſalt to thoſe who have the Goal Diſtemper. Might it not, therefore, be adviſeable for Convicts and Slaves, when they come on Ship-board, to drink ſometimes Water acidulated with a few Drops of Spirit of Salt, and ſometimes to take a little of the acid Spirit of Tar, and ſometimes a gentle exhilerating Purge of Sea-water; and often to bathe in Sea-water. It may be well alſo to fume with burning Brimſtone between Decks, the People being all above-deck. There will be little Expence or Trouble in theſe Precautions. Dr. *Addington* and Dr. *Linde*, give good Directions in their Books, for preſerving Health in Ships.

376. IN Caſes where it is requiſite to keep the Ports ſhut, and there are no Ventilators in a Ship, it is propoſed to open, or partly open, (according to the different Strength or Coldneſs of the Wind) the aftermoſt Port on the Weather-ſide, and at the ſame time to open, in the ſame Degree, the Port neareſt

the Ship's Head, on the Lee-ſide; and when the Wind and Waves will permit, and is directly at the Stern of the Ship, then to open a Gun-room Port; thereby to cauſe a Draught of freſh Air between Decks, from Stern to Head; the Degree of which may be known by the Bend of the Flame of a Candle. According to the Force of the Wind and Waves, either the Gun-deck or middle-deck Ports are to be opened. If the Air which enters at the Stern-port ſhould incommode thoſe who are neareſt the Port, the Force of the entering Wind may be much abated by a Canvas, properly tacked or looped up, at ſome little Diſtance from the Port, ſo as to be a Screen to divert the direct Force of the entering Wind. This Method is to be uſed in Ships that have no Ventilators, and probably, ſometimes in Ships with Ventilators, thereby to ſave ſome of the Labour of working them.

377. In the Caſe of Ships at Anchor, where the Wind is full a-head, it is propoſed to have one or both the foremoſt Ports of the Gun-deck opened, more or leſs, according to the Degree of Force or Coldneſs of the Wind: And in order the better to direct the Wind or Air to turn into the Ship, to fix a

Piece of Canvas, by means of Loops or Loopholes, to ſmall Tenter-hooks, drove into the After-ſide of the Port-holes, and alſo acroſs the Under-ſide of the open Port, from its After-hinge Corner, to the oppoſite-outer fore Corner: The lower and fore Borders of the Canvas to be looped to Sticks tied together at the lower fore Corner; whence another Stick, tied faſt at that Corner, is to reach with its other End to the lower Part of the open Port-hole, to be faſtened there. It is probable, that the extended Canvas being thus fixed obliquely, at an Angle of 45 Degrees, will give the Wind a Turn into the Ship, ſo as to cauſe it to paſs between Decks, to the open Gun-room Ports, which, if it does in any Degree, will doubtleſs make the Ship the more healthy, by clearing off its foul Air.

378. AND whereas, when in Storms the Sailors and the Inſide of Ships, are very wet, by the Openings of the Seams of the Decks, that wet State will be more unwholſome in a cloſe unventilated, than in a ventilated Ship; in like manner as a cloſe-ſhut wet Room in a Houſe, is much more unwholſome than with Doors and Windows open. Thus alſo, it is not unhealthy to walk on the damp Earth in

a free, open, though damp Air; whereas it is well known, that a like or leſs Degree of Dampneſs of the Floor and Air, in a cloſed Room, is very unwholſome. It is, therefore, a Matter of the greateſt Importance to be very careful frequently to change the Air in a damp Ship; the noxious Quality of which damp Air is much increaſed by the great Degree of its Putrefaction, cauſed by the Heat in the Ship, and the large Quantity of putridly-diſpoſed Vapour, which ariſes from a great Number of Perſons; *viz.* no leſs than 1200 Pounds Weight from 500 Men, in 24 Hours, at the Rate of 39 Ounces from a Man, as Dr. *Keil* found it, eſpecially when this Damp and Vapour is confined by cloſed Ports, by reaſon of Wind and the great Agitation of the Waves, for a conſiderable Time after the Storm.

*378. A PROBABLE Means lately occurred to my Thoughts, though not perfectly to cure, yet much to abate the Degrees of ſtinking of the Bilge-water, in the Well of a Ship; *viz.* by laying at the Bottom of the Bilge-water, round the Main-maſt, Copper Pipes full of very ſmall Holes, not one twentieth of an Inch in diameter, and blowing Showers of

Air up through them, from ſmall Bellows, fixed out of the Way, within the Well: Such Bellows may be worked with great Eaſe, for one, two, or three diſtant Quarters of an Hour, in every 24 Hours, more or leſs, as ſhall be found requiſite by Experience: But with this Precaution, that whenever the Water ſtinks much, firſt to pump it out of the Ship, and after letting in ſweet Water, then to ventilate it a little now and then, as ſhall be found needful; but care muſt be taken not to ventilate very ſtinking Water, becauſe it may increaſe the Unwholſomeneſs of the foul Air in Ships. By this means Ships will probably be made ſomething the leſs unhealthy; for the putrid Vapours which ariſe from ſtinking Water, muſt needs greatly contribute to increaſe the Putridneſs, and conſequently the Noxiouſneſs of the foul Air in Ships, eſpecially in unventilated Ships. This Precaution, with Ventilators frequently to convey off the cloſe foul Air, will be a good Means to make Ships much more healthy.

379. As to the Method of drawing off Air by means of Fire-pipes, it is no new Invention, but was publiſhed by Sir *Robert Moray*, in the *Philoſophical Tranſactions*, in the

Year 1665: And was many Years ſince applied unſucceſsfully for drawing Air out of the Houſe of Commons.

380. AND as it has been ſince applied, in preference to Ventilators, to the drawing Air out of Ships, not only for preſerving the Health of the People at Sea, but alſo the Ships from decaying when laid up in ordinary; it is therefore incumbent on me to ſhew the comparative Quantities of Air drawn off by the Fire-pipes, and by Ventilators.

381. THE Fire-pipes are metalline Pipes, about two Inches and half in diameter, one of which reaches from the Fire-place to the Well of the Ship; the other three Branches go to other Parts of the Ship. The Stoke-hole and Aſh-hole being cloſed up, the Fire is ſupplied with Air through theſe Pipes.

382. THE Draught of Air through theſe Fire-pipes, is ſometimes ſufficient to blow out a lighted Candle; but it is much oftener ſo weak, as not to be able to do it; as is found by Trials, purpoſely made: Particularly in the *Namure*, Admiral *Boſcawen*'s Ship, in his Expedition to the *Eaſt-Indies*, in the *Invin-*

cible, then a Guard-ſhip at *Portſmouth*; and of eight *Nova-Scotia* Tranſport-ſhips, in the Year 1749: The In-draught of the Air was ſo weak, that only one of them extinguiſhed the Flame of a Candle, held at the Mouth of the Pipe in the Well by Order of the Right Honourable the Earl of *Halifax*, who was preſent at the Trial. This Defect has been artfully concealed, by burning Flax, whoſe broader Flame covering the Orifice of the Pipes, is more ſenſibly drawn in, and ſoon extinguiſhed. There is alſo another Method of diſpoſing the Fire-pipes in Uſe, which conveys ſtill much leſs Air; *viz.* by carrying the Pipes through the Fire, thereby cauſing a ſmall Draught, by rarifying the Air in the Pipes.

383. Now, in order further to prove the very ſmall Quantity of foul Air that is drawn off by the Fire-pipes, I made the following Experiment; *viz.* I fixed the Noſe of common Kitchen Bellows to a wooden Trunk, which was 19 Feet long, and equal to three ſquare Inches in the Clear within-ſide. Upon working the Bellows, a lighted Candle held at the other End of the Trunk, was blown

out, and the Air ruſhed forcibly upon the Hand, and would have done the ſame, had the Trunk been much longer; ſince whatſoever Air was blown in by the Bellows, muſt neceſſarily ruſh out at the other End of the Trunk.

384. Now, I had found by a former Trial, made on another Occaſion, that thoſe Bellows would convey ſo much Air at each Stroke, as would amount to 37 Tuns in an Hour, which is but one ſixty-third Part of 2340 Tuns; which the Ventilators in five of the *Nova-Scotia* Tranſport-ſhips, can convey off in an Hour. And the In-draught of the Fire-pipes of ſeven of the Ships, was ſtill leſs than this, for it was not ſufficient to extinguiſh a Candle, though the Trials were made when the Fires under the Boilers were at their greateſt Height, and conſequently drew moſt Air: Whereas a conſiderable Part of the Time that the Fires are under the Boilers, is taken up in raiſing the Fires, and in their Declenſion; which being allowed for out of the four Hours, during which I am informed the Fires are continued in the Tranſports, greatly increaſes the Diſ-

proportion between the Quantities of Air conveyed by the Fire-pipes and Ventilators. By this means the People have not any Refreſhment of Air, for a conſiderable Part of every twenty-four Hours; and no Refreſhment at all when they moſt of all ſtand in need of it; that is, in Storms, when all the Gratings are cover'd, and there can be no Fires. In this Caſe, when the Storm continues long, it muſt needs be very detrimental to the Health of the People.

385. WHEREAS Ventilators may be worked during a Storm, and, if Need required, inceſſantly, Night and Day: Which if it were done, ſuppoſing there were 200 Men in a Tranſport-ſhip, then it would come to every Man's Turn, once in forty-eight Hours, to work half an Hour, at a very eaſy Work. But it has been found by Experience, that the working the Ventiltaors half an Hour every four Hours, preſerved in good Health near 200 Men, for almoſt a Year, in the *Succeſs* Frigate. In this Caſe it will come to every Man's Turn but once in ſixteen Days to work for half an Hour, and that at a Work which it has been found by Experience, they have

done even with Eagerneſs and Pleaſure, being much of Opinion that it was for their Health. Yet this has been one of the grand Objections to the Uſe of Ventilators; on which Account they were long ſpoke of with Scorn and Contempt, to the Loſs of many Thouſands of Lives, which might have been preſerved, if they had been made uſe of ever ſince they were firſt invented, in the Beginning of the Year 1741.

386. ANOTHER Way of eſtimating the very ſmall Quantity of Air that is drawn off by the Fire pipes, in compariſon of what is done by large double Ventilators, is this; *viz.* Whereas the Fire-pipes can only extinguiſh a Candle when held cloſe to their Noſe, my ſmall Ventilator, (*Fig.* 6.) which is about the Size of a Sailor's Cheſt, will extinguiſh a Candle at the Diſtance of five Feet and eight Inches from the Noſe, which is ſixteen ſquare Inches wide: Which ſhews that the Fire-pipes muſt needs convey much leſs Air than theſe ſmall Ventilators; which convey 300 Tuns in an Hour; which, though above eight times more than the Fire-pipes can do, would yet be very inſufficient for duly purifying the Air of a Ship; becauſe the Quantity of Air which

thoſe ſmall Ventilators convey, is but $\frac{1}{12}$ Part of what the Ventilators in the *Captain* can convey, and but $\frac{1}{78}$ Part of what the Ventilators in the *Nova-Scotia* Ships can do; and would, therefore, be very inſufficient to purify the Air of a Man of War, or Tranſport-ſhip; much leſs can the Fire-pipes do it. And their Inſufficiency to preſerve Ships healthy, is confirmed by Experience.

387. BESIDES the Advantage of better preſerving the Health and Lives of People, and alſo of the Proviſions, ſuch plentiful Ventilation will contribute conſiderably to the Preſervation of the Timbers and Planks of Ships, if during the Ventilation the Hatches of the lower Deck being cloſed down, the Air be drawn through the Cieling from between Decks, among the Timbers, or Ribs, down into the Hold; and this eſpecially if all the Seams of the Cieling of the Hold be calked, or cloſed, with Liſts of brown Paper paſted over them, except ſome of the lower Seams, which are above the Bilge-water: By which means alſo, all the foul Air in the Hold from the Keelſon to the lower Deck, will be drawn off: For the freſh Air will enter the Hold towards its lower Part, and this will greatly

contribute to the better preſerving all kinds of Proviſions, Store-ſails, and Goods in the Hold, which are often damaged by its hot putrid Air.

388. CAPTAIN *Ellis*, Author of the Account of his Voyage to *Hudſon*'s Bay, and now Governor of *Georgia*, wrote me the following Account, from on-board the *Halifax* Slave-ſhip, at *Cape Monte*, *Africa*; *viz.* he took a Wax Candle, of eight to the Pound, and drew it through a Mould, to make it of one Thickneſs, from End to End; and found it waſted 67 Grains, in burning thirty Minutes in the Hold, which had not been ventilated in twenty-four Hours: But after ſix Hours Ventilation, it waſted 94 ½ Grains in the ſame Time, *viz.* ⅓d more.

389. HE placed in the Hold a well-poliſhed Silver Plate, with a Candle and Lanthorn, all blinded except a round Hole of two Inches diameter: He placed the Plate at ſix Feet diſtance from it, and with ſuch an Obliquity, that the Rays of Light ſhould fall on its Surface, at an Angle of 45 Degrees. He then fixed a white Paper Skreen, at the ſame Diſtance from the Plate, and under the ſame

Angle with the Lanthorn, that the reflected Rays might fall upon it. He then obſerved, that the Reflection from the Plate laſted diſtinctly but ſeventeen and half Minutes, with an unventilated Hold, it being turned the Colour of tarniſhed Lead: Whereas, when the Hold was filled with freſh Air, by four Hours Ventilation, the Plate continued to reflect Light, and retained its Brightneſs four Hours and 41 Minutes.

389. WHEN Ventilation had been omitted twelve Hours, he hung the Ship's Bell under the lower Deck, took out the Clapper, and ſuſpended it by a Line, which with its own Length, made 44 Inches: The Angle which the Rim of the Bell made, with a Line let fall perpendicular from the Pin on which the Clapper hung, was equal to 34 Degrees. He then held the Clapper at the ſame Angle, on the other Side of the Line, in order that the Strokes at different Times might be with the ſame Force: When letting it go, it ſtruck the Bell; in its Return he catched it, and counting the Vibrations, he heard them diſtinctly but three Times; whereas, when the Hold was well ventilated, it vibrated five Times, but its Vibrations were not ſo quick in the latter as

in the former Caſe. He took all poſſible Precautions that theſe Experiments might be fairly tried, to prevent Deception, but always found them to produce the ſame Effect. The Cargo-Arms, which were in upright Cheſts, without Wrappers, retained their Poliſh.

391. We ſee in theſe curious and accurate Experiments, the great Difference in the Purity and Impurity of the Air, of a ventilated and unventilated Ship, and, conſequently, the plain Reaſon why, when ſuch a foul Air putrifies, it not only impairs the Health, and cauſes the Death of Multitudes, but alſo damages all kinds of periſhable Goods, Store-ſails, Proviſions, *&c.* and even promotes the Decay of the Ship, whoſe Timbers will doubtleſs rot faſter with a hot putrid, than with a freſh cool Air.

392. The People on-board were all healthy for a conſiderable time; *viz.* till the Ventilators were ſo ſpoiled by the Rats eating not only the leathern, but the wooden Parts of them, in ſuch a manner, that they were obliged to give over the Uſe of them long before they had any Sickneſs, when many of their Slaves died of extremely infectious Diſtempers;

pers; as Small-pox, Meaſles, Fluxes, and Fevers, which came upon them almoſt all at once. The ſpoiling of Ventilators by Rats, might be prevented by anointing them either with Aloes diſſolved in Lamp Spirits, or by Verdigreaſe mixed with Pitch and brown *Spaniſh*.

393. IN order to find the different Degrees of Warmth of the Sea at different Depths, I provided and ſent by Captain *Ellis* the following Sea-gage, which was a Pail, or Bucket, to bring up Water from great Depths of the Sea; it was 10 ¾th Inches deep, 11 ½ wide above, and 8 ½ wide at the Bottom. There were round Holes both through the top and bottom Heads, each four Inches diameter, which were cover'd with ſquare Valves, which opened upwards on Braſs Hinges; they were cover'd with Leather on their lower Part: They both opened and ſhut at the ſame time, by means of an Iron Rod, which was fixed to the upper Part of the loweſt, and the under Part of the uppermoſt Valve: So that as the Bucket is let down into the Sea by means of a ſinking Weight, the Water opens both the Valves, and paſſes freely through the Bucket, which, when it is

as low as it is to go, being, after ſome delay, pulled up again, the Valves will ſhut, and bring up the Water from great Depths; with *Farenheit*'s Mercurial Thermometer fixed in it, to a moveable Stick, which may eaſily be taken out, it being fixed by Iron Pins both at the Top and Bottom; Then drawing out the upper Pin, the Stick may be eaſily taken out with the Thermometer fixed to it: But the Ball of the Thermometer muſt not be taken out of the Water till the Degree is obſerved at which the Meridian ſtands. And, in order to this, it will be requiſite to put a Cork into the Hole at the Bottom, when the Bucket is drawn up to the Ship, to prevent the running out of the Water when the Valves are opened; alſo to preſerve the Water, in order to know its degree of Saltneſs; In order to keep the Bucket in a right Poſition, there are four Cords fixed to it, which reach about three Feet below it, to which Cords the ſinking Weight is to be fixed.

394. He made ſeveral Trials with this Sea-gage. In Latitude 25° 13″ north, Longitude 25° 12″ weſt, he charged it, and let it down to different Depths, from 360 Feet to 5346 Feet, when he diſcover'd by the Thermometer,

meter, that the Cold increaſed gradually in proportion to the Depths, till it deſcended to 3900 Feet; *viz.* near three quarters of a Mile, whence the Mercury in the Thermometer came up at 53 Degrees; and though he afterwards ſunk it to 5346 Feet, *i.e.* a Mile and 60 Feet, it came up no lower: The Warmth of the Water upon the Surface, and that of the Air, was at that time 84 Degrees. He with good reaſon thinks, that the Water was a Degree or two colder when it entered the Bucket, becauſe in coming up it muſt probably have been warmed in ſome degree, for he found, that the Water which came up in the Bucket, after having ſtood 43 Minutes in the Air, (the time of winding it up) the Mercury roſe above five Degrees. When the Water in the Bucket was, by ſtanding a due time, of equal Warmth with the Water on the Surface of the Sea, he tried, by weighing equal Quantities very exactly, as alſo by the Hydrometer, their Weights, and found, that from below the heavieſt, and, conſequently, the ſalteſt. With this cool Water they ſupplied their Bath, and cooled their Wine, which was very refreſhing to them.

395. I HAVE ſhewn in my Treatiſe on Ventilators, Numb. 42, 55, the great Quantities of volatile Vapours which go off from human Bodies, both by Perſpiration and by Breath; and alſo, how apt ſuch Vapours, when long confin'd, are to turn putrid, and thereby produce the peſtilential infectious Diſeaſe, called the Goal Diſtemper, or Fever: And it is this putrid bad Quality of the foul Air, and putrid Bilge-water in Ships, where there are many People, which is one of the principal Cauſes of that common Diſtemper, the diſpiriting Scurvy, of Fluxes, and other Diſtempers.

396. IN order the more effectually to rouſe the Attention of Mankind, in a matter of the greateſt Importance to the Health and Lives of thouſands, and thereby the more fully and clearly to convince them of it, I have had the following Experiments made, by placing lighted Candles in ſuch foul cloſe confined Airs; it being well known, that the vital Lamp of Animals is either inlivened and invigorated, or incommoded and quenched, in proportion to the different Degrees of Purity or Impurity of the Air which they breathe in.

397. I HAVE found, after variety of Trials with Candles of different Sizes, that the larger Candles, of about ſix to the Pound, are beſt for the Purpoſe; and in order to prepare them for theſe Experiments, it is proper to cut off, or waſte by burning, one-fourth or one-third of the Candles, where they are uſually ſmaller and taper, *viz.* till they are nearly of an equal cylindrical Size: Then firſt weighing the Candle, when it is well lighted, begin to eſtimate the time, for its burning half an Hour in a good Air: Then put it out with an Extinguiſher, that a fair Snuff, with its black Part about half an Inch long, may be preſerved; if it be too long, ſnuff it to a due Length, in order to fit it for further Trials in foul Airs, it being of great Importance to begin each Trial with a good Snuff: The Candle muſt be weighed again after each Trial, by burning both in good and foul Air: And in order to preſerve a fair Snuff in carrying a Candle into a Mine, &c. it may be well to make a Caſe for it of Cards, nailed in a ſemi-circular Form to the Sides of a flat Piece of Wood, about an Inch and a half wide; or to wrap it in ſtiff Paper with a Stick.

398. If ſeveral Candles are prepared at the ſame time, by burning them firſt in a good Air, they may be marked Numb. 1, 2, 3, by Holes made near the Bottom with a Pin's Point, and filled with Ink, with the Nib of a Pen; for every Candle which is uſed in theſe Experiments muſt firſt be tried in a good Air.

399. I desired a Surgeon of the ſecond Regiment of Foot-Guards, to burn a Wax Candle, of about half an Inch diameter, for half an Hour, among the ſick Soldiers at the *Savoy*, where it waſted but 11 Grains; whereas the ſame Candle, in a good Air, had waſted in the ſame time 27 Grains, which is more than double of what it waſted in that bad foul Air: And he ſays that the Stench there is ſometimes ſo intolerable, that Candles give but a very weak Light.

400. The cloſe and low Situation of the *Savoy* Priſon, makes it the more requiſite to have thoſe Rooms ventilated. Mr. *Adair*, a Surgeon, who was on Ship-board with the large Embarkation of Soldiers, which lay ſeveral Months wind-bound in the Channel, and which invaded *France* in 1746, told me,

that great Numbers of *Harriſon*'s and *Frampton*'s Regiments died of the Goal Diſtemper, with which they were infected, by about 40 Men inliſted among them, who being Deſerters from the *Engliſh* in *Flanders*, and taken in the late Rebellion going from *Dunkirk* to *Scotland*, who being confined in the *Savoy*, there got the Goal Diſtemper. He told me alſo, that in *Flanders* they dreaded the having of Recruits from the *Savoy*, being apprehenſive that they would bring with them the Goal Diſtemper.

401. DR. *Langriſh* made the like Experiment, at my Deſire, with a Wax Candle, of ſix to the Pound, juſt before the *Lent* Aſſizes, in the Dungeon of *Wincheſter* Goal, in the Morning, before Doors or Window-ſhutters had been opened: The Candle, which had waſted 88 Grains in half an Hour, in a good Air, waſted but 66 ½ Grains in the Dungeon, in the ſame time, which is near one-fourth leſs; and Mr. *Thomas*, a Surgeon of *Chelſea* Hoſpital, obſerved the like Diſproportion in burning a Tallow Candle, of ſix to the Pound, in a pocky Room. After the Dungeon had been well ventilated for half an Hour with the Ventilators, the Priſoners re-

maining there all the while, the ſame Candle waſted in another half Hour, 87 + $\frac{1}{2}$ Grains, that is, very nearly as much as in the good Air at firſt; which ſhews the great uſe of Ventilators both in Goals, Hoſpitals, and Ships. The Doctor obſerved, that at the firſt going down into the Dungeon, the foul Air affected the Mouth and Throat with a remarkable Saltneſs, but not at all at their going down after it had been well ventilated.

402. In St. *George*'s Hoſpital, near *Hyde-Park Corner*, a like Tallow Candle, which in a good Air, had waſted in half an Hour, 77 + $\frac{1}{2}$ Grains, waſted in the King's Ward, early in the Morning, before Fires were kindled, 70 Grains, *viz.* $\frac{1}{11}$th Part leſs: And even this leſs Degree of Foulneſs in the Air, by putrifying, is obſerved to cauſe putrid Diſeaſes, and to be very hurtful, not only to conſumptive Perſons, but alſo to thoſe with broken Limbs, who have their Health impaired thereby, inſomuch that they find it requiſite of late to leave the Wards ſometimes vacant, in their Turns, for a time, to be aired, cleanſed, and fumed with the acid Fumes of burning Brimſtone.

403. IN Dr. *Stonehouſe*'s Stable at *Northampton*, with four Horſes in it, a Candle, placed near the Cieling, at firſt opening the Door in the Morning waſted $\frac{1}{6.7}$ leſs, which ſhews that this Air was fouler than that in the King's Ward: Dr. *Stonehouſe* has, therefore, let freſh Air into the Stable, through Holes made in the Wall, with much broader Boards fixed within-ſide, at a ſmall Diſtance, to ſpread the entering Air thin, ſo as not to blow directly on the Horſes; a laudable Practice, which ought to be imitated in many Stables, where the Horſes breathe too hot and foul an Air; whereas a freſher Air would make them more vigorous, and leſs apt to catch Cold.

404. A PLANT of Spare-mint in a Glaſs of Water, being, at my Deſire, fixed near the lofty Cieling of the *King's* Stable in the *Mews*, *London*, faded and died ſoon; a Proof of the Foulneſs and Unwholſomeneſs of that cloſe Air, which Grooms and Coachmen are ſo fond of, and which it is moſt eaſy to refreſh, to the great Benefit of the Horſes.

405. AS there are various Degrees of the Unwholſomeneſs of the Air of Mines, ſo it

will doubtleſs be of great Importance to have a ready Way to know what thoſe ſeveral Degrees of Unwholſomeneſs are in different Mines, and in different States of the ſame Mine, at different Times, and in different Parts of Mines: And this may be done with ſufficient Accuracy, by means of lighted Candles. In order to which, I procured the following Experiments to be made in ſeveral Mines, *viz.*

406. SIR *John Philips*, Bart. of *Pickton* Caſtle, in *Pembrokeſhire*, had a Candle burnt at the further End of the Level, or Drift, of a Coal-mine at *Bigelly*, which was 42 Fathom ſix Feet and a half from the Pit, and eleven Fathom four Feet deep under the Surface of the Ground; where it waſted but 49 Grains and a half, *viz.* leſs than half of what it had waſted in a good Air, which was 101 Grains: So this Air muſt be unwholſome to a conſiderable degree.

407. I WAS obliged to the Reverend Mr. *Emmerſon*, of *Middleton*, near *Barnard-Caſtle*, *Durham*, for making the like Experiments with lighted Candles, in Lord *Darlington*'s Lead-mines, in his Pariſh; where he found

they waſted, in burning 15 Minutes, in ſome Places ſeven Grains, in others 11, 13, and 15 Grains leſs than in a freſh Air, more or leſs, according to the different States of the Air not only in the Mine, but alſo above-ground, as to its Weight or Lightneſs, Wind or Calm, which made ſome Alteration.

408. IN the Drifts, while digging to the Air-ſhafts, the Air is very noxious; ſo that a Candle will burn only when held inclining ſide-ways. But Mr. *Emmerſon* having placed a ſmall Ventilator, (*Fig.* 6.) at the Entrance of an Adit, that was digging 50 Fathom to a new Air-ſhaft, where the Miners complained much of the Badneſs of the Air when they were got about 20 Fathom, inſomuch that they could work but few Hours at a time; yet when the Air was renewed through a long Trunk, which reached from the Ventilators to the Miners, they could then work all the Day with Pleaſure. This cheap and eaſy Method of Relief is, therefore, not only of great Benefit to the Health and Lives of the Miners, but will alſo be very profitable to the Proprietors and Owners of Mines. On communicating the Succeſs of this Method of ventilating Drifts while digging, to Mr. *Percival*

tival at *Briſtol*, he put it in Practice in his Mines in *Cornwal*, and that with ſo good Effect, that it is like to become a general Practice in that Country.

409. AND it is to be hoped that this will lead to the Uſe of the large double Ventilators, (*Fig.* 2.) layed on each other, as at *Newgate*, in the great and more noxious Mines, where they may be worked either by a Stream of Water in the Mine, or above-ground, or by the Fire-engine that drains the Mine, or by a Wind-mill, which works above three-fourths of the Year, and when becalmed, by Horſes.

410. MR. *James Sterling*, who, at my Deſire, burnt the like Candles in Lord *Hopetoun*'s Lead-mines, at the Lead-hills near *Edinburgh*, found the following Diſproportion in Places where the bad Air is; *viz.* at the Depth of 50 Fathom a Candle waſted 71 Grains, which in a good Air had waſted 99 Grains. In another Place, at the Depth of 83 Fathoms, 61 Grains; in a good Air $81 + \frac{2}{1}$: And at 44 Fathoms depth, though the Difference of the Waſte of a Candle was but

92 Grains to 85, *viz.* but ſeven Grains, only $\frac{1}{13}$th Part leſs; yet this Air is eſteemed ſo bad, as to be unfit for working in: But in the Drifts, where there is a free Courſe for Air, or a good Current of Water, without regard of Depth, there the Difference of the Waſte of Candles is very little, and the Air not unhealthy: But where Candles can ſcarcely burn, Men cannot work, though they may remain there 10 or 15 Minutes, without Inconvenience. The Reaſon why a Stream of Water makes a Mine healthy is, becauſe the Air riding on the running Water, is carried away with it, and cauſes a Succeſſion of freſh Air.

411. Mr. *Sterling* found thoſe Lead-hills ſo high, that the mercurial Barometer ſtands there, at a Medium, one Inch and two-tenths lower than at *Hopetoun* Houſe; which Houſe, as he conjectures, ſtands about 40 Yards higher than the Sea.

412. In digging unhealthy Pits or Shafts, the noxious Vapours of them, and the Fumes of Gunpowder in ſplitting Rocks, may be blown out by the ſmall Ventilators, (*Fig.* 6.)

through a Trunk about four Inches in the Clear, within: And a tarred Canvas Trunk, about ten Feet long, diſtended with very ſmall Hoops, may be fixed to the lower End of the wooden Trunk; which, being flexible, will eaſily comply with the ſeveral Diſtances of the deepening Bottom of the Pit, where the Men are working.

413. Mr. *Percival*, of *Briſtol*, informs me, that it has long been the Practice, immediately after each Blaſt of Gunpowder, to throw down a Fuze Faggot, or to pour down two or three Buckets of Water; but as the Water thus falling in a large Bulk, cannot waſh all Parts of the Air ſo well as a Shower of Water through the Roſe of a watering Pot, I propoſed to him the uſing ſuch artificial Showers, which they find more advantageous for purifying the Air in a Shaft, as it not only waſhes with its many Streams and Drops all Parts of the Air, but alſo carries down a greater Quantity of freſh Air, by means of its much larger Surface, when thus minutely divided, than when it falls in a larger Bulk. It may be well for the Man who holds the Watering-pot, to ſtand on the ſame Side of the Air-ſhaft that the Wind is, and to hold

the Pot as high as he conveniently can, that the falling Shower, by avoiding ſome of the Smoke, may carry down with it the more freſh Air; Water and Air attracting each other.

414. In Caſes where it is required to have freſh Air deſcend by one Air-ſhaft, and aſcend by another at a conſiderable Diſtance, to increaſe the Quantity of the deſcending Air, they cauſe a Stream of Water to run down that Shaft; but the Quantity of deſcending Air would be very greatly increaſed, if that Water was divided into many ſmall Streams like Rain, by falling through innumerable ſmall Holes, made in the Leaden or Copper Bottom of a ſquare Veſſel, as large as the Air-ſhaft, leaving open the Spaces between the Sides of the Veſſel and the circular Sides of the Shaft, for a Supply of Air to deſcend. The ſame Method will alſo be beneficial in purifying, with little Water, the noxious Air in the *Well* of Ships. It is obſerved by Phyſicians, that a Shower of Rain will make ſome unhealthy States of the Air healthy. Thus a Shower of Rain greatly checked the Ravage of the laſt great Plague in *London*.

415. *Francis Blake*, Eſq; F. R. S. informs me, that they carry on their Drifts of Communication double betwixt Pit and Pit, breaking here and there Holes through the Partition, that thereby the Air may be made to circulate, when by Fire or otherwiſe its Equilibrium is deſtroyed; which Methods, though ſufficient, in moſt Caſes, to prevent immediate Death to the Workmen, yet he thinks it inſufficient to render Mines near ſo wholeſome, as Ventilators of a proper Size would make them. He ſays further, that it were to be wiſhed that Ventilators could act jointly with the preſent Methods now in uſe, both to render them more wholeſome, and alſo to obviate what ſome object, *viz.* That if, whilſt Men are at work in a noxious Mine, the Ventilators, their ſole Dependance, ſhould break, what muſt become of them? But this Objection is of little Weight, unleſs the noxious Vapours immediately fill the Pit, before the Miners have time to get out, upon the Ventilators ceaſing to work. But, allowing this Objection its full Force, he thinks Ventilators would be of uſe to act in Conjunction with the preſent Methods that are in Uſe, as they would conduce to the better Health of the Labourers, whoſe State, he ſays, is very deplorable;

plorable; they earning their Bread in Mines, juſt not noiſome enough to ſhew an immediate ill Effect, but who, at every Breath, draw in ſuch bad Air, as haſtens the Period of their Lives. And here, doubtleſs, Ventilators would be of great Uſe, by much increaſing the Quantity of freſh Air that would thereby be impelled into the Mine. But the moſt effectual Method to have the Miners breathe freſh and wholeſome Air would be, to have the Air conveyed through a large Trunk, from the Ventilators to the Place where the Miners are at Work; and by this means the fewer Air-ſhafts would do, ſome of which, as I am informed, are ſunk at a great Expence. The Trial mention'd Numb. 28, Vol. 1ſt, was an imperfect Trial.

416. Mr. *Eraſmus King* very rightly propoſes to have Ventilators worked by the Fire-engines, in Mines, which would abate but very little of the Force of the Fire-engine; becauſe as the Stroke of that is ſeveral Feet, and the Stroke of the Midriffs of the Ventilators but 12 or 16 Inches, ſo the Lever of the Ventilotors may be proportionably the longer, and conſequently be worked with ſo much the leſs Force.

417. BY the Favour and at the Deſire of *John Birkhead*, Eſq; of *Iſleworth*, the following Trial was made by Mr. *Lambe*, of St. *Auſtel* in *Cornwal*, with three Mould Candles, of ſix to the Pound; *viz. Nov.* 16 they burnt firſt for half an Hour, in a good Air, and waſted, Numb. 1, 99 Grains, Numb. 2, 100 Grains, Numb. 3, 99 Grains. The ſame Candles waſted, in burning half an Hour in a Tin Shaft, where they were 27 Fathom below the Surface of the Ground, and ſeven Fathom below an Adit of good Air, and three Fathom horizontally from the Bottom, 27 Fathom Adit, where they could but juſt keep a-light; Numb. 1. waſted 61 Grains, Numb. 2, 55, Numb. 3, 51 Grains: At the further End of this Place, which was three Fathom further, a Candle would not burn but when held ſide-ways ſlanting.

418. MR. *Lambe* gives the following Deſcription of Damps in the Tinners Words, *viz.* "A damp confined Air is a Thing that "deprives a Man of Breath; firſt, when he "comes into it, there is a calm thick Miſt; "when he ſets about working, his Breath "decays; the Duſt that ariſes from the "Tools, or Pick, and the Smoke of the

"Candles, all go into him; ſo that he "breathes for Life with great Difficulty; and "what he ſpits or brings out of his Lungs, "is as black as Ink: He will ſoon have a "ſhort tickling Cough, and if he does not "take care in time, he will not be able to "move out of the Place. In a great Damp "the Flame of the Candle is ſmall and white, "and can't be perceived to move, and ſometimes "it will quench in an Inſtant: The "more Candles are burnt the worſe he "breathes: The Damp is moſt in boggy "Ground; not ſo bad when there is Water "in the Shaft; very bad in calm ſultry Weather; "and when the Wind is briſk it clears "great Part of it: A Man that works in "theſe Damps looks very pale, and complains "of a great Heavineſs on his Breaſt. Theſe "Damps are from ſeven Fathom to 36 Fathom "moſtly."

419. THE Tinners air the Shafts, by means of a long Trunk 2 + $\frac{1}{2}$ Inches wide, wide mouthed, with a Head fixed at the Top, which always turns to the Wind; this might effectually be done, and that in calm Weather, by blowing Air down now and then, through the widened Trunk, with a ſmall Ventilator;

by this means fewer Air-ſhafts would do, which Air-ſhafts, when ſunk, give a Current to the Air: Sometimes they tie a Bundle of Furzes to a Rope, and by pulling it up and down, render the Air better for many Hours; which ſhews, that a ſmall Ventilator, which would refreſh more effectually, need not be conſtantly worked.

420. As the ſame Method of eſtimating the Degrees of Foulneſs of Air in Hot-beds and Green-houſes, may probably be of ſome Uſe, when further Trials ſhall have more accurately ſettled the wholſome and unwholſome Degrees of thoſe Airs; for freſh Air is of great Importance to the Health and Thriving of Plants and Trees, as well as to Animals; for Purity of Air, as well as Warmth, is neceſſary for their thriving in Hot-beds and Green-houſes: I ſhall, therefore, give an Account of the few Trials which I made.

421. I FOUND the Heat of a Heap of Dung, by *Farenheit*'s Mercurial Thermometer, to be 104 Degrees above the freezing Point, which is more than half the Heat of boiling Water. *January* 14, a Candle which, in a good Air, waſted in burning half an Hour, 65 Grains,

waſted 50 Grains, $\frac{1}{4.3}$ leſs in a Hot-bed not cover'd with Mold: The Heat of the Dung was 33 Degrees. *Jan.* 18, the Air was ſo foul as to extinguiſh the Candle, though the Glaſs Cover had been on but half an Hour. The Heat of the Air under the Frame was 52 Degrees, but the Heat of the Dung much greater. *Jan.* 21, the Dung cover'd with Mould: The Candle waſted 49 Grains; the Heat 34 Degrees. The Bed is now in a healthy State for Seeds. *Feb.* 1. the Candle waſted 49 Grains; the Heat of the Air in the Frame 54 Degrees; the Cover of the Frame was raiſed near half an Inch, to let in freſh Air; the Heat 15 Inches; in the Dung 92 Degrees; the Heat of the external Air 17; the Cucumber Plants were in good Health. I made the like Experiments with lighted Candles, in ſome warm Green-houſes at *Hampton-court*, and found a ſenſible Difference as to the Purity of different Green-houſes, but have loſt the Minutes of thoſe Trials.

422. THE Air at the upper Part of hot Pine-houſes is remarkably offenſive; at the ſame time that the lower Air, and near the Floor, is pleaſant and agreeable. The Degrees

of Unhealthineſs of this upper Air might probably be known, by having ſome of the ſame kind of Plant, as Mint, *&c.* in two Pots, one of the Pots to be placed on the Floor, the other near the Cieling in the bad Air, where Plants have been killed; the noxious Vapours of which, when condenſed into Drops, damage the Plants they fall on: Which Inconvenience may, in a good meaſure, be prevented by refreſhing this Air cautiouſly, with Pannels of Reeds, at the upper Part of each End of the Houſe, in order thereby gradually to convey off the foul and lighteſt upper Air.

423. THESE and the like Experiments with Candles, will be of great uſe to ſhew the Degrees of Unhealthineſs of the foul ſtagnant Air in Goals, Hoſpitals, Ships, and Mines; but with this Diſtinction, *viz.* that a leſſer degree of Foulneſs of Air long confined, being thereby become the more putrid, will, on that account, be more noxious than a greater degree of Foulneſs of Air which has not been long enough confined to become putrid. Thus the long ſtagnant Air of a common Goal, in which there are comparatively much fewer Perſons than in a Ship, will breed the in-

infectious Goal Diſtemper; whereas the much fouler Air of a Ship, crowded full of Perſons, if it has not been long enough confined to putrify, may not produce that Diſtemper; though, when long confined, it frequently produces that Diſtemper, the Scurvy, Flux, and other Diſeaſes, which are the bad Conſequences of a putrid Air, which is the principal Cauſe of the Scurvy. Perhaps frequently repeated Experiments with Candles in the Rooms of thoſe who are ſick of different Diſtempers, may lead to eſtimate the different Degrees of Putridneſs of ſome Diſtempers, as alſo ſhew the different Effects that putrid and unputrid Diſtempers have on burning Candles: At leaſt it ſeems very probable, that repeated Trials with Candles, in the Rooms of thoſe who are ſick of the moſt putrid and offenſive Diſtempers, will ſhew when it is requiſite, in ſome meaſure, to abate the great Degree of Foulneſs of ſuch Air, by cautiouſly admitting freſh Air, and keeping the Bed-curtains cloſe for a ſhort time, till that freſh Air is grown warm, as has been ſometimes practiſed with Succeſs. And whereas a cool freſh Air, though admitted in but ſmall Quantities into a hot Air, will immediately deſcend, ſo as to be ſenſibly felt;

might it not, therefore, be adviſeable to admit the freſh cool Air near the Floor of the Room.

424. I SHALL next give an Account of rational and eaſy Methods to purify the Air, and regulate its Heat in Melon-frames and hot Green-houſes, *viz.* 1. By taking a Pane of Glaſs out at each End of the upper Side of a Melon-frame, or Hot-houſe, and then fixing to the Rails of the Frame a Board over the Hole, with a round Hole in it, about four Inches in diameter; the Board to be like a Wedge, ſo much thicker at the lower End than the upper, as to have its Surface horizontal, on which to fix a wooden or Tin Tube (by ſliding under ſmall Ledges or Moldings, the lower ſpread-out Part of it, ſo as readily to put on or take off) the Tube to be four Inches in diameter, and a Foot high, with a Cowle on it, made readily to turn to and fro by means of a Vane, ſo as to have its cloſed Side always to the Wind, and its open Part from the Wind; for the foul Vapours which ariſe from the Dung, and Perſpiration of the Plants, to paſs off inceſſantly as they riſe: And this, without admitting any cold Air, as is done in the common Method, by raiſing the

Glaſs-covers a little, which endangers the Plants ſuffering by Cold. It is probable that more than two of the Tubes will be wanting in long Frames; for the Plants are found to flouriſh beſt that are neareſt theſe: Square wooden Tubes with Vanes on them, may probably be better than Tin Tubes, which in cold Weather may condenſe, and thereby, in ſome degree, check the Aſcent of the Vapours.

425. When, therefore, Plants by this means conſtantly enjoy a freſh Air, they will probably thrive with more Vigour, and alſo become more hardy, by being always in a temperate Air, than when they are ſometimes ſtewed in the foul, hot, and cloſe confined Vapour of the Hot-bed and Perſpiration of the Plants, freſh pure Air being as requiſite and ſalutary for Plants as for Animals. There is in the middle of the Tin Tube a round Valve, which turns on an Axle, ſo as to open or cloſe the Tube more or leſs, when it ſhall be found needful, in proportion to the different Degrees of Heat of the Dung or Bark, and the different Temperatures of the outward Air: Or there may be a ſliding Shutter at the lower End of the Tube.

426. It is very probable, that the Flavour of Melons and Pines will, by this means, be conſiderably more delicate than when in the common Way they are long ſtewing in the foul Vapour of Dung or Bark, and of what perſpires from the Plants: For, it is a matter of common Obſervation, that the Fruits on Trees both thrive more kindly, and are alſo the better flavoured, the more freely they perſpire in a pure Air.

427. There is another Improvement which, as I have lately found upon Trial, will be of further conſiderable Benefit in Melon-frames and Hot-houſes, *viz.* I laid ſloping in a Heap of hot Dung, a leaden Pipe, which was eight Feet long, and an Inch and quarter wide within: The lower End of the Pipe, which was bent a little downwards, was expoſed to the open Air, near the Surface of the Ground: The upper End of the Pipe, being bent upwards, came upright out of the Top of the Dung-heap, near the other End of the Heap.

428. The next Morning, at ſeven, a mercurial Thermometer being let down eight Inches into the upper Part of the Pipe, the

Heat of the aſcending Air raiſed the Mercury to 111 Degrees above the frezing Point, that is, almoſt to two-thirds of the Degree of Heat of boiling Water, which is 180 Degrees above the freezing Point. So the external Air being then 16 Degrees above the freezing Point, it was heated 95 Degrees, in two-ſeconds of Time, in paſſing the Length of eight Feet up through the Pipe. Whence it may be eſtimated, by making that Air viſible by Smoke, thereby to know its Velocity, that there paſſes through the Pipe about ſeven Tuns of Air in an Hour, and in 24 Hours, 168 Tuns; and this inceſſantly, Day and Night, as long as the Dung retains its Heat: And as its Heat abates, ſo will the Heat and Quantity of the aſcending Air abate.

429. In order, therefore, to have a conſtant Supply of freſh warm Air, it may be well to have three or four Pipes in each Melon-frame, or ſeveral more in Hot-houſes, to reach five or ſix Feet beyond the Back or North-ſide of the Frame, to be cover'd ſucceſſively with freſh hot Dung as the former grows cold; And there may be more than one Pipe in each Dung-heap, if required; and if the Bottom of the Dung-heap is a Foot under-ground, to

give the Pipe a greater Slope, the more Air will aſcend up it. Qu. Will it not be well to have each ſeparate Dung-heap incloſed with Boards at the Sides?

430. Or rather, a conſtant Succeſſion of warm Air may be let into Hot-houſes, by having ſloping Pipes to paſs through the End-walls near the Ground, and alſo near the Inſide of the North-flue hot Wall, four, five, or more Yards long, according to the Length of the Hot-houſes, through which Plenty of warm, pure, freſh Air, will inceſſantly aſcend.

431. After *September* we have not Heat enough to correct the Crudities which are imbibed in the long Nights, from the Vapours of the warm Bed, and from the Perſpiration of the Plants: But when theſe foul Vapours are inceſſantly carried off through theſe Tubes, the Plants will not be ſubject to be ſuffocated with foul Vapours, nor be made too tender by being too much heated, but will be the more hardy; and will, through their whole Progreſs, thrive more kindly, by having a more free Perſpiration, in a pure warm Air; nearly reſembling the Summer ſalutary open Air.

432. And as Hot-houſes will by this means be filled with a conſtant Succeſſion of warm, wholſome, freſh, unburnt Air, and the natural Floor of a Hot-houſe or Melon-frame thereby ſufficiently warmed, for the Growth of ſeveral Kinds of Plants; it ſeems probable, that they will grow and thrive then in the midſt of Winter, covering the Glaſſes with Mats in very cold Weather.

433. And by the ſame means, the Air of too cloſe and ſmoking Dwelling-rooms, may be refreſhed, by having Pipes three or four Yards high in the Corners of the Rooms, with their lower Ends paſſing through the Walls, the Pipes being in ſome degree warmed by the Warmth of the Room, the freſh outer Air will conſtantly aſcend warm, ſo as not to incommode Perſons even in Winter. It may be well to have the lower End of the Pipe bent downward on the Outſide of the Wall, to prevent ſtrong Winds blowing up it. Qu. Will not ſuch refreſhing Pipes be of conſiderable Benefit in the Chambers of the Sick?

434. It has in many Inſtances been obſerved, that the Air of Chambers over Rooms

where Charcoal is burnt, is very bad; as over the high-pitched Aſſay-office at *Goldſmith's* Hall, and over large Kitchens where there are ſeveral Stoves of burning Charcoal, whoſe Fumes are not conveyed away through a Chimney, *&c.* I cauſed a live Chicken to be held up near the Cieling of a Room where Charcoal was then burning, in the middle of a large Kettle of Water: After ſome time, the Chicken became ſo languid and faint, that it could not ſtand. And, as ſuch ſubtile and ſulphureous Fumes aſcend with great Velocity upwards, ſo I have known an Inſtance where they penetrated the Cieling and Seams between the Boards ſo much, as to incommode thoſe who lay in ſuch Chambers, to ſuch a degree, as to oblige them to riſe in the Night, and open Windows to admit freſh Air, to prevent being ſuffocated.

435. AND here it may not be improper to mention an excellent Method which, by often repeated Experience, has been found effectual in curing moſt ſmoking Chimnies, *viz.* not to have the Mantle high, and from the Mantle to build the Sides and Breaſt upright for two or three Yards; the Sides to be no further diſtant from each other than the Width of

the Fire-grate; and the Breaſt but 10, 14, or 16 Inches diſtant from the Sides of the Throat or Back of the Chimney, which will make the lower Surface of the Mantle to be a broad horizontal Plane; a very material Circumſtance. The ſide Jaumbs from the Hearth to the Mantle, to deſcribe a Curve. When Chimneys have a good Draught, it greatly contributes to the having freſh exhilerating Air in a Room.

436. The airing the Wards of Hoſpitals, in which there is a conſtant Succeſſion of ſick Perſons, does not ſeem ſufficient: But in order to cure the putrid Infection adhering to Cloaths, Walls, *&c.* it ſeems requiſite to have it ſometimes done by the Fumes of burning Brimſtone.

437. When we breathe a foul Air, the Lungs being not thereby ſo much dilated as in a pure Air, the Blood cannot paſs ſo freely through the Lungs to the Heart as it ought to do, and, conſequently, the Circulation of the Blood through the whole Body muſt, in ſome degree, be retarded; which Circumſtance alone muſt tend much to vitiate the Blood, for the more the Lungs are dilated, ſo much

the more freely does the Blood paſs through them; as was evident in the Caſe of the ſighing Horſe, which Action, by dilating his Lungs, made the Blood preſently riſe the higher in the Glaſs Tube which was fixed to his crural Artery. *Hæmaſticks*, p. 16. And this Reaſoning will hold proportionably, in relation to the Foulneſs of the Air in the Wards or Chambers of the Sick: And, therefore, to let in freſh Air, with due Precautions, has been found of great Benefit to the Sick of ſome Diſtempers, particularly in that nauſeous Diſtemper the Small-pox, which fouling the Air much, great Relief has been found by admitting freſh Air.

438. It is obſerved of the Lace-makers, that they are of a very ſickly Countenance, which Unhealthineſs is probably owing to their conſtantly being in a very ſtooping Poſture over the Lace-cuſhion; in which prone Poſition they cannot duly dilate their Lungs, by drawing in a ſufficient Quantity of Air, which muſt needs be very unwholſome; whereas many Women who lead as ſedentary Lives in many other Employments, enjoy better Health. And doubtleſs, in leſſer Degrees of ſtooping forward for a long time, as

in Tent-work, or other Employments, there will be a proportionable Inconvenience from the thereby leſſened Inſpirations. The ſame is alſo obſerved in ſome Parts of *England* where they have got a habit of leaning in a very ſtooping Poſture, with their Elbows on their Knees.

439. ON the *Andes*, the higheſt Mountains in the World, they can breathe very freely, *viz.* becauſe the cold Air deſcends faſt to the lower Parts of the Lungs, and there being expanded by Warmth, dilates the Lungs: Whereas on *Teneriff*, where they breathe a warm or hot Air, the Breathing is incommoded. This quick Deſcent of very cold Air to the lower Part of the Lungs, is thought to cauſe Pleuriſies in the South of *France*, and the like cold Places: To prevent which, many draw their Breath in through a Handkerchief applied to the Mouth. There is ſometimes, with an eaſterly Wind, on the Coaſt of *Guinea* and of the *Red-Sea*, a duſty Air, which is unwholſome. The like is mentioned *Deuteronomy* xxviii. 24. *The Lord ſhall make the Rain of thy Land Powder and Duſt; from Heaven ſhall it come down upon thee, until thou be deſtroyed.* When we breathe

a freſh Air, it deſcends to the lower Part of the Lungs, and thereby drives out the lighter warm foul Air: But when in crowded Rooms, we breathe an Air as hot and damp as that in the Lungs, we then only change in breathing the upper Air in the Lungs, the lower Air being equally hot and light, as the new-breathed upper Air, and, conſequently, of equal Weight, the lower Air cannot be changed; but by continuing to grow fouler and fouler, gives that uneaſy Senſation which is called a pent Breath. Thus I have found by Experiments, as have ſeveral others, that the ſame Gallon of Air can ſcarcely, and with great Difficulty, be breathed to and fro for a Minute, by reaſon of its great Degree of Foulneſs. It is, therefore, a Matter of great Importance, to uſe Means to change the Air of ſuch Rooms, by a conſtant gentle Succeſſion of freſh: But it muſt not be let in at full open Windows, eſpecially in cold Weather, becauſe it will fall down precipitately, and incommode the Company. There will be another great Convenience in thus changing the Air of crowded Rooms, *viz.* that they will not, when they go out, have the dangerous Inconvenience of a ſudden

Change, from a very hot to a very cold, inclement Winter Air.

440. As to the common ſick Rooms of private Houſes, it is the Advice of the learned Doctor *Tſchrinhaus*, in his *Medicina Corporis*, *frequently to change the Air of a ſick Room, eſpecially if the Sickneſs have been long*; becauſe it is then become putrid: And the good Effect of this Practice is found by Experience in the Small-pox Hoſpital, as is above-mentioned, Numb. 262. And this is eaſy to be done in a moſt gentle and ſafe Manner, by leaving the Chamber-door open for ſome time; as is evident, by holding a Candle to the upper Part of an open Door-caſe, where by the inclining of the Flame, it appears, that the Air goes out of the Room: But if the Candle is held a little lower, the Flame is upright, which ſhews a ſtagnant State of the Air: But when held in the lower half of the Door-caſe, the greater Bend of the Flame ſhews, that the cooler, heavier, external Air ruſhes into the Room, and thereby drives out the upper, lighter, more noxious Air, which is thereby happily changed for freſh Air, that principal, genuine, ſalutary Cordial of Nature; which thoſe who uſe themſelves too

tenderly, are apt to ſhun, as ſuppoſing it unwholſome, becauſe cool; not conſidering, that a hot, cloſe, foul Air is, in reality, the unwholſome Air. This Experiment ſucceeds beſt at the Door of a Chamber in which the Air is warmed by a Fire, or by Perſons being in it for ſome time. The Endeavours, therefore, to prevent the Admiſſion of any freſh exhilerating Air, by double Doors, liſting Crevices, *&c.* are doubtleſs wrong, and is often the Occaſion of a diſpiriting ſmoky Air in Rooms. When it is conſidered how ſmall the Quantity of Air in the Head of a Cradle is, for a Child to breathe to and fro, can it be thought ſalutary to confine it very cloſe, not only with a Lining, but alſo with Curtains. Were a Child to breathe that ſmall Quantity of Air as cloſe confin'd as in a Box, it would doubtleſs be ſmother'd in a few Hours.

441. Mr. *Tidd*, Clerk of her Royal Highneſs the Princeſs of *Wales*'s Spicery-office, has contrived a Method to admit freſh Air into a Room, in a commodious Way, by taking out the middle upper ſaſh Pane of Glaſs, and fixing in its Place a Frame-box, with a round Hole in its Middle, about ſix or ſeven Inches

diameter, in which Hole are fixed, behind each other, two or three little twirling Windmills, with Sails of very thin broad Copper-plates, which ſpread over and cover the whole circular Hole, ſo as to make the Air which enters the Room, to ſpread round in thin Sheets ſide-ways; ſo as thereby not to incommode Perſons by its blowing directly upon them, as it would do, were it not hindered by the Mill-ſails, which turn on the ſame Axle-tree or Spindle, each leſs than the other. This Method of refreſhing Rooms is much approved of, and uſed by many, not only in *England*, but alſo in other Countries.

442. THE ingenious Dr. *Pringle*, in his Obſervations on the Diſeaſes of the Army, ſays, "That putrid Diſeaſes are very apt to "be bred in Hoſpitals, Barracks, Priſons, "and Tranſport-ſhips, and in every crowded "Place, where the Air is long pent up, ſo "as to be corrupted by the perſpirable Mat-"ter of the Body, which, as it is the moſt "volatile Part of the Humors, is alſo the "moſt putreſcent: Hence it is, that in pro-"portion to the Naſtineſs of ſuch Places, "the Number of Dyſenteries and foul Sores, "but above all, of Mortifications, a malig-

"nant Fever is both frequent and mortal." And he further ſays, "It is incredible in "how few Days the Air will be corrupted "in thronged and cloſe Wards: And what "makes it harder to remedy the Evil is, the "Impoſſibility of convincing either the Nurſes or the Sick themſelves, of the Neceſſity "of opening Doors and Windows at any "time for the Air: I have always found "thoſe Wards the moſt healthy when, by "broken Windows and other Wants of Repair, the Air could not be excluded.— "The Putrefaction of Fleſh advances quicker "in a confined than a free Air, becauſe the "moſt putrid Parts being the moſt fugitive "and volatile, they inceſſantly iſſue from a "corruptible Subſtance, and diſperſe with "the Wind: But in a Stagnation of the Air, "they remain about the Body, and by way "of Fermentation, excite it to Corruption." Hence it is, as the Doctor obſerves, "That "Goals are the frequent Source of malignant "Fevers in Towns;" which the ventilating of them will effectually prevent. "Hence "alſo it is, that the calm ſtagnant Air of a "Country, with Moiſture and Heat, is bad "and unwholſome; but this Moiſture and "Heat, without ſtagnant Air, is not ſo putrid

" and bad." Which ſhews how ſalutary Wind is, and at the ſame time the Reaſon why in Ships Men are very liable to Diſtempers from moiſt and corrupt Air confined. And in his Treatiſe on Hoſpital and Goal Fevers he obſerves, " That the Degree of Contagion " and Malignity of theſe putrid Fevers, de- " pends upon two Circumſtances; firſt, the " long Continuance of Putrefaction in the " ſame Place, and, ſecondly, the Degree and " Quantity of it. We have an Inſtance of " the firſt Kind in Goals and Dungeons, " which are perhaps left foul for Ages; and " where, by reaſon of the long Succeſſion of " animal Filth and Naſtineſs, the putrid " Ferment is exalted to ſo high a Degree, " that the very Breath and Cloaths of Male- " factors will ſpread the Infection. The " ſecond is moſt apparent in Hoſpitals, " which though of no long ſtanding, yet " by the great Quantity of putrid Exhala- " tions, will produce the ſame Effect." He obſerves further, " That a foul Hoſpital will " turn any Diſtemper into a malignant " Fever."

443. AND no wonder that a human Body, that is of itſelf ſo ſubject to Putrefaction,

ſhould be apt to fall into a putrefying State, when it is unhappily ſituated in the midſt of a very putrid Air, which is drawn in great Plenty into the Lungs, and thence ſpreads its Putrefaction into the Blood and Humours of the Body. No wonder then that, as the Doctor obſerves, "there is a great Tendency "to Putrefaction through the whole Courſe "of the Diſeaſe: A principal Means for the "Cure of which is, as he obſerves, to breathe "freſh Air."

444. As the moſt putrid Vapours are the moſt ſubtile and volatile, ſo I obſerved them to be in the Court at the *Old Baily*, *May* 11, 1750, when I was obliged to be there; and found the Smell of the Air in the Gallery on the right Side of the Court, ſenſibly more offenſive than below, when I was called down among the Crowd, to give Evidence. And accordingly, thoſe who were ſituated higheſt in the Court, as the Lord-Mayor, Judges, *Middleſex* Jury, and thoſe in the Gallery on the left Hand of the Court, were chiefly infected with the fatal Contagion; on which Side a wide Saſh-window facing the Judges, was open; at which an eaſterly Wind entered, which might blow down the moſt venomous

Vapour which was near the Cieling, and condenſe in ſome degree, and check the ſubtile infectious Vapour, heated by a crowded Court for many Hours, from aſcending ſo faſt from among thoſe on the Bench and in the Left-hand Gallery: Whereas on the Right-hand, where no Window was open, the ſame Heat might cauſe the envenom'd Vapour to aſcend quicker to the lofty Cieling; as it is well known ſuch Vapours conſtantly do in Rooms full of crowded Aſſemblies.

445. As to the preſerving the Timbers of Men of War, laid up in ordinary, the longer from decaying, the following Method was made uſe of, *viz.* all the Seams between the Planks on the Outſide of the *Sheerneſs*, a 20 Gun Ship, at *Deptford*, were caulked, to prevent the eſcaping of the Air in waſte through them: And the lower Seams of the Cieling, or inner Lining in the Hold, were cleared; the lower this is done ſo much the better, that the freſh Air may enter among the Ribs as low as poſſible. The Seams of the Cieling of the Fore-part of the Ship were opened about an Inch wide, to give a free Paſſage to the Air, and thereby prevent its Dampneſs and Mouldineſs, by too ſtagnant

an Air. The Seams next under the Cells of all the Port-holes, and juſt over them, were alſo opened, to give a free Paſſage for the freſh Air, for want of which they are very apt to decay there. The Ports ſhut cloſe againſt ſeveral Folds of Liſt nailed to the Sides, Bottom and Tops of the Port-holes. All the inner Seams of the Gun-wale, above-deck, caulked, except the uppermoſt Seam, which is opened all round the Ship, for the Air to paſs freely off; and except alſo the Seam juſt above and under the Sell of each Port-hole, the Hatches of the lower Deck, and all Holes through it, Gratings, Hawſe-holes, Chimney, and all other Outlets for Air, to be well cloſed. The Lining or Cieling was alſo cloſed under the lower Deck, which is uſually left open. It ſeems beſt to blow the freſh Air into the cloſed Ship, becauſe there being thereby ſome degree of crowded Air, it is more likely that it will be compreſſed into many more Seams and narrow Meanders of the Ship, than if the Air were drawn out of the Ship; becauſe when the Air is drawn out of the Ship, the freſh Air will be drawn in at the Seams of the upper Part of the Ship, and little or no Part of the freſh Air will be brought down among the Timbers of the lower Part of the Ship: Whereas, when it is directly blown down to the lower Part of the Hold, it muſt aſcend thence through the loweſt widened Seams, up among the Timbers to the upper Parts of the Ship.

446. At the firſt Trial, only one Sett of ſuch double Ventilators as are uſed in *Newgate* were put into the *Sheerneſs*, and worked by a Wind-mill fixed on the Main-deck; but the Fore-part of the Ship being mouldy and damp, for want of opening the Seams of the Cieling of the Fore-part of the Ship, to give a freer Paſſage for the Air; it was thought adviſeable, in order the more effectually to ſucceed, to have four Setts of ſuch Ventilators, *viz.* two between Decks, and two in the Hold, all to be worked by the Rod of one Wind mill, which convey into the cloſed Ship at the Rate of 14,000 Tuns of Air in an Hour, when the Mill turns at the Rate of 15 Times in a Minute; and more or leſs, in proportion to its greater or leſs Velocity.

447. *Auguſt* 11, 1752, when the four Setts of Ventilators worked at the Rate of 20 Strokes in a Minute, all Hatches, Gratings, *&c.* being cloſed, the Blaſt of Air into the

Ship was ſo great through the whole Ship, that no ſingle Timber could probably eſcape the good Effect of it; for the Flame of a lighted Candle, held to the Seams, in almoſt all Parts, was ſenſibly blown into them; not only among the more open Timbers, but alſo in the Channels, where the Dead-eyes are fixed to hold the Maſts, in which Places there is a Bed of Timber laid together very cloſe. And this was chiefly done by three new Setts of Ventilators, the old Sett being much damaged by pulling in Pieces, and lying by neglected.

448. A COMMON Quart Bottle being filled about one-fourth full of Water, and having a Glaſs Tube a Foot long, cemented at its Noſe, the Tube went to the Bottom of the Bottle, and was filled half full of Water; the Water in the Tube ſunk about half an Inch at every Stroke; by which means we have a true Eſtimate of the Force with which the Air is impelled into every Seam and Crevice, *viz.* with a Force nearly equal to the Weight of that Part of an Inch Depth of Water. Now, ſuppoſing a Gallon of Water to be five Minutes in running through a Hole, the Mathematicians have demonſtrated that

24 Gallons of Air would paſs through in the ſame time, with the ſame Preſſure or Force; which ſhews, that great Quantities of freſh Air muſt needs paſs through all the Seams and Crevices of the Ship: And wherever freſh Air comes, we are aſſured that Timber will not decay, as it is well known to do in a damp, cloſe, confined, putrid Air: Of which there are innumerable Proofs in Ships, Houſes, and every Mortice and Tenon which is ſubject to wet, where it conſtantly decays much ſooner than in other Parts of the ſame Timber that are expoſed to be wetted by every Dew and Rain, but have withal freſh Air. And that it is the cloſe, putrid Air, and not the wet, which is the great and principal Cauſe of this Decay, is demonſtratively evident from hence, *viz.* thoſe Timbers of Ships that are conſtantly cover'd with Water, ſo as no Air can get at them, laſt long; as do alſo Elm Piles, and ſeveral kinds of Timber, which have probably, ſome of them, lain wet in Bogs above a thouſand Years, and yet ſound, becauſe no Air can get at them. And it has been obſerved by Ship-builders, that the Timbers of Ships which have been caulked on the Inſide, have decayed ſurprizingly ſooner than the Timbers of Ships that have not been thus caulked:

And alſo the cloſer the Timbers are to each other, provided they are not ſo cloſe as to exclude any degree of Air, ſo much the ſooner they are apt to decay. Thus the cloſe confined Air between the outer and inner Lining of a Ship, and between the outer Planks and the Ribs, deſtroy thoſe Timbers, and corrode the Trunions aſunder like *Aqua Fortis*; ſo that wherever we ſee Timbers, when laid open, decayed, we may be aſſured that it is done by that moſt ſubtile and powerful Diſſolvent, cloſe, confined, putrid Air.

449. WHENCE it may moſt reaſonably be inferred, that wherever freſh Air can be conveyed among the Timbers of a Ship, thoſe Timbers will moſt undoubtedly be preſerved much the longer from decaying. And by thus ſeaſoning the Timbers of a Ship, by drying away the Sap as it perſpires, they will become the more tough and hard: The *Sheerneſs* was made very dry by this Ventilation: And when the Sap is thus dried away, Timber becomes very durable. Thus Beech, which is very ſubject to decay and to be worm-eaten, becomes very durable, and not ſubject to be worm-eaten, if when cut out into proper Scantlings for Uſe, it be laid a

proper time in Water to ſoak out its Sap, and then be carefully dried under Cover, and not in the Sun. And I am credibly informed, that even Elm Planks, thus well ſeaſoned, will make very durable Barn-floors, leſs ſubject to ſplinter than Oak; a Matter of great Importance now that Oak grows more and more ſcarce.

450. But if the Timbers of Ships did not dry by this Ventilation, yet a cloſe, confined, putrid Air (that moſt ſubtile and powerful Diſſolvent) will decay thoſe Timbers much ſooner than a freſh Air will do, even though they continued damp or wet; for it is not, we ſee, Wetneſs alone that decays Timber. Therefore, to find Means to convey plenty of freſh Air among the Timbers of Ships, is moſt aſſuredly to find Means to preſerve thoſe Timbers much the longer from decaying.

451. Of this we have a ſtrong Proof in the caſe of Beams and Joyces of Floors over Cellars, which are well known to laſt above 200 Years without decaying, though never throughly dry, where the Air can freely paſs through the Windows; whereas the Timber of Cellars and Ground-floors, ſo cloſed up that

no freſh Air can enter, are well known to rot ſoon. Thus alſo the Stalls, Pews, &c. in Cathedral Churches laſt ſome hundreds of Years, notwithſtanding that in damp States of the Air the Stone-walls and Pillars drip with wet, and, conſequently, the Stalls, &c. muſt needs be very damp; yet they are obſerved to continue long ſound, *viz.* becauſe they are ſurrounded with freſh Air.

452. As to the Intervals of Calm, they are not uſually ſo great as to give time for the Air to putrefy, at moſt to any conſiderable Degree; of this we have a Proof in the Timber of the lower Floors that cover Cellars, with open Windows for the Air to paſs through, when the Wind blows, notwithſtanding the Intervals of Calm. There cannot, therefore, in the Nature of the Thing, be more probable and ſtrong Reaſons given for ſucceeding in this important Affair: We muſt be content to wait a conſiderable time for full Proof from Experience.

453. But were it neceſſary or adviſeable, in order the more effectually to preſerve Ships from decaying, to have a conſtant, uninterrupted Ventilation of Air, this might be done

by keeping a Horſe or two conſtantly on-board, to work the Ventilators in calm Weather; the Expence of this would be inconſiderable, in compariſon of the great Benefit in preſerving ſuch very expenſive Fabricks.

454. AND as it is found by Experience in many Ships, that the Hold and Inſides of Ships are much cooler and ſweeter by Ventilation, ſo it is reaſonable to conclude, that the Ventilating of Ships at Sea by the Labour of Men, will not only be a Means of preſerving the Health and Lives of many, and alſo of the better preſerving Proviſions; but will be alſo of conſiderable Benefit in preſerving the Ship itſelf ſomething the longer from Decay; and this as ſurely as it is certain that Ships will decay faſter with a hot, cloſe, confined, putrid Air, than with a cool, freſh Air. Thus the Timbers of our *Eaſt-India* Ships are found to be very ſubject to Decay, by reaſon of the hot, foul, putrid Air in the Hold. Hence it is alſo, that Store-ſails, Ropes, and even Cables, are damaged thereby.

455. THE Reverend Dr. *Tucker*, of *Briſtol*, informs me, that the Ships which bring Yarn ſo ſhort a Voyage as from *Ireland* to *Briſtol*,

are apt to decay very faſt in the Hold, *viz.* by the very hot and putrid Moiſture of the Hold; for Heat greatly accelerates and increaſes the Force of Putrefaction. Thus it has been obſerved, that if the Guts are taken out of Pigeons or Fowls while they are warm, they will taint and putrefy much ſooner than if taken out when cold, *viz.* becauſe Warmth accelerates the Putrefaction of the cloſe, confin'd Air in their hollow Carcaſs, which is impregnated with the ſtagnant Vapours of the Animal: Whereas the Lungs of Animals which have conſtantly a moiſt, warm Vapour in them, do not rot, *viz.* becauſe that foul Vapour is continually refreſhed with pure Air, ſo as not to have time to putrefy: And, conſequently, when the Hold is kept cool with freſh Air, it will not be apt to rot ſo faſt as when hot.

456. FROM the very putreſcent Nature of the Sap of Wood, there is Reaſon to ſuſpect that this Quality may tend greatly to increaſe the putrefying Power of the damp putrid Vapour which is confined among the Timbers of Ships; to prevent which, this Method of ventilating Ships ſeems an effectual Remedy, by carrying off this greatly putreſcent, ſappy

Vapour, which, in Ships built of green Timber, is found to be moſt deſtructive of the Health and Lives of Men. And this is fully proved by the following judicious Experiment, which Mr. *Slade*, Surveyor of the Navy, made, *viz.* *May* 1754, he cut eight Pieces of very green Oak, of an equal Size, and put four of them between the Timbers of the *Sheerneſs*, a twenty Gun ventilated Ship; and the other four into the like Places, in the *Syren*, a twenty-four Gun Ship, with *Fire-pipes* and open Ports, which Ship lay alongſide of the *Sheerneſs*. The *November* following, two of theſe Pieces, from the like Parts of thoſe Ships, were taken out, when the Surface of that from the ventilated Ship appeared quite dry, and that from the Ship with *Fire-pipes* was cover'd with a green, hairy Dew or Fungus. The Pieces were replaced again in their former Situation, and taken out the *May* following, when that from the ventilated Ship was remarkably dry, and that from the Ship with *Fire-pipes* did not appear ſo bad as before, the hoary Mildew being dried to a kind of green and blue Powder; occaſioned, as he thought, by the extreme Drineſs of the Weather. The Piece of Oak in the ventilated Ship weighed two Pounds five

Ounces, and that in the *Syren* two Pounds eleven Ounces; ſo that ſix Ounces more of Sap were evaporated from the ventilated Piece than from the other, *viz.* about $\frac{1}{7}$th Part of its Weight: A Proof of a very material Thing, *viz.* that the Timbers of a ventilated Ship are in a State of ſeaſoning, and that to a conſiderable Degree in the Space of a Year. This is therefore what Philoſophers call an *Experimentum Crucis*, which proves and ſhews the Nature of the Thing enquired after, like a Croſs in a High-way. And the Timbers of Ships thus ſeaſoned will laſt much longer, by decaying ſlower, when at Sea, than the Timber of unſeaſoned Ships, beſides the great Advantage of being more healthy.

457. New Ships are probably ſubject to decay more, in equal Times, than older Ships, from the more plentiful ſappy Evaporation of the new Timber; which being, as it is well known, of a very putrefying Nature, makes ſuch Ships more unhealthy than old Ships are, that are equally or more damp with watry Moiſture. If ſo, then Ventilation is of more Importance to new Ships than old ones, and probably the putrefying Dampneſs will

ſooner be dried away in new than old Ships, where it has had time to ſink deeper into the Timbers.

458. IN the *Prince*, a 90 Gun Ship, the four double Setts of Ventilators were placed on the Gun-deck, between the Pumps and the main Capſtan; two Setts on the Starboard, and two Setts on the Larboard Side, with their circular Ends within three Inches of each other: By this Poſition the four Levers are parallel to each other, that is, the Levers of the two headmoſt are parallel and near each other, as are thoſe of the ſternmoſt. In order to have all theſe Levers worked by the Rod of the Wind-mill, it was neceſſary to have a fifth main Lever hung on a central Pin, 12 Inches above the other Levers; which, with the Stroke, was all the Room to ſpare under the middle Deck. Each End of the great Lever was connected to the other Leavers, as in Fig. 17. The lower Part of the Swivels *B B*, take hold of two Levers, and the upper Part of the Ends of the main Lever. By this means all the Ventilators are worked by the Rod *A*, which comes down from the Wind-mill, on the Quarter-deck. Each Sett

of Ventilators conſiſts of two Ventilators, two being laid firſt Side by Side, and the other two on them; which, being thus connected, fit one Noſe; by which means they may, when Occaſion requires, be very commodiouſly moved from Ship to Ship, without taking in Pieces. Their Midriffs are nine Feet long, and four and half Feet wide. The Trunks of theſe Ventilators paſs through the Hatch-ways down into the Hold, into which they convey the freſh Air. The Gun-deck and Deck over it are caulked.

459. THERE are Holes cut in the Middle of the Front of the Side-noſtrils, with ſliding Shutters, to blow freſh Air, as Occaſion ſhall require, between Decks: At which time the Deſcent of the Air into the Hold, is prevented with ſliding Shutters. And leſt theſe Openings ſhould all at once be inadvertently ſhut, which would endanger the Spoiling of the Midriffs, for want of a free Paſſage for the Air, therefore this Inconvenience is provided for in the following Manner, *viz.* by cutting a Hole at the Top of each outer Noſtril, which Holes are cover'd with an half Inch thick Fir Board, with a leathern Hinge. This Board is to be of ſuch a Weight, as not to

open in common Ventilations, when there is a free Paſſage for the Air down into the Hold; but then only to open when thoſe Paſſages are ſtopped; which cauſes the Air to be impelled with a greater Force: And, therefore, theſe may properly be called ſniffling Valves, *viz.* ſuch as are uſed to prevent burſting of the Engines which raiſe Water by Fire.

460. The Mill-frame is bolted firm with a ſcrew Bolt, which is fixed to an Iron Poſt, which connects the Quarter and Middle-deck firmly together, which prevents the cutting of a Hole in the Upper-deck, as was done in the *Sheerneſs*. By this means the Mill may eaſily and readily be taken down. The Mill-rod, which reaches from the Axle-tree of the Mill down to the Ventilators, is kept ſteady at each Deck by Sockets of hard Wood.

461. When the Wind-mill is fixed on the Main.deck, as was done to the *Sheerneſs*, then it muſt be of ſuch a Height, as not to have its Sails ſkreened from the Wind by the Quarter-deck or Fore-caſtle; in the *Sheerneſs* the Axle-tree was 17 Feet above the Main-deck. The Mill turns to face the Wind by means of a large Fane of Boards behind. It had eight

Sweeps or Arms, twelve and half Feet long. In order the more effectually to ſtrengthen theſe eight Arms, which are mortiſed into the central Piece of Wood, the Iron Axle-tree is extended forward about two Feet; from the Extremity of which, Iron Braces went to each Arm, to which they were faſtened by Iron Pins, which paſſed through a ſtrong Iron Circle of ſix Feet diameter, and through each Arm, where they were ſcrewed faſt; by this means the Arms were effectually ſtrengthened.

462. As an Angle of 55 Degrees is found, both by Mathematical Calculation, and alſo by my own Experience with a ſmall Mill placed before the Noſe of my Ventilators, to be the Degree of Weathering, as Mill-wrights call it, or the Angle, or Degree of oblique Poſition of the Sails to the Wind, for gaining the greateſt Force; ſo an Angle near that, *viz.* of 60 Degrees, has been found by Experience, to do very well in ſuch ſmall Mills: But in common Wind-mills, with very long Arms, the Obliquity of the Sails ought to be leſs, elſe their Velocity towards the Extremities, will cauſe a counter-acting Force at the Back of the Sails. The great Obliquity of

the Sails of theſe Ventilator-Mills, has this further great Advantage, that it will move with weaker Winds, which therefore ſomething lengthens the Duration of the Time of the Mill's going: Which Mr. *Yeoman* has obſerved to be ſomething more than three-fourths of a Year in *Northamptonſhire*; and will be more where there are Tides or Rivers, which are found to give Motion to the Air that rides on ſuch moving Waters.

463. If common Wind-mills were conſtructed in this Manner, it ſeems to me probable that the Arms or Sweeps might be ſomething ſhorter than they uſually are, ſome of which I have known to be 32 Feet long; whereas, could they be made to perform the Work with ſhorter Arms, it would be much more commodious in ſeveral Reſpects.

464. The Crown-tree and Sheer-tree have Iron Plates let into their under Sides, which bear upon the two Collars, which are turned true with the Mill-poſt, and plated with Iron truly ground on its Surface; by which means the Mill turns about very eaſily, without any Hazard of its getting out of Order: The Mill-rod is kept ſteady by hard Pieces of

Wood let into the Mill-poſt: The upper Part of the Rod is of Wood, with hard Pieces of Oak fixed in it, where it embraces and takes hold of the Crank; this Wood is preferable to Braſs, not only as it makes leſs Noiſe, but alſo as it is more durable, it having a Bearing ſix Inches wide: The Brake which ſtops the Mill is of Iron, which being leſs tenacious than Wood, will not ſo ſuddenly ſtop the Mill in Storms, and thereby endanger the twiſting the Neck off.

465. THE Crank of the Iron Axle-tree of the Mill is ſeven Inches long, thereby making a Stroke of 14 Inches. The Iron Rod reached down to the great Levers of the Ventilators, to which its Side-brackets were fixed at ſuch a Diſtance from the Center of Motion of the Levers, as to raiſe and fall the Midriffs twelve Inches: In order to which, the Depth of the Ventilators ſhould be ſuch as to leave full half an Inch above and below, more than the Midriffs riſe and fall, in order to avoid the great Inconvenience of their ſtriking againſt the Top or Bottom.

466. CARE muſt be taken to open the ſeveral Seams of the inner Lining or Cieling

of the Ship, in ſuch Places, and in ſuch Proportion, as may beſt conduce to admit as much as poſſible a due Proportion of freſh Air to all Parts; which may be gueſſed at by the Flame of a lighted Candle, held near the Seams in ſeveral Parts.

467. AND whereas there may be Trouble, and ſome Damage, in taking out many Planks of the Cieling, or to examine ſome particular Places where it may be doubtful whether the Air paſſes; the following Method occurs to me in doing it, *viz.* to bore Auger-holes, of about an Inch diameter, in the Cieling Planks; through which to put either green, or well ſoaked oaken Pins, made rounding at each End, that they may readily be pulled out by a String nailed at one End, by which they may be ſuſpended within the Cieling Planks. In order to this, they muſt not be altogether ſo long as the Diſtance between the two Linings. They muſt be each numbered and weighed, in order to keep a Regiſter of them. The Auger-holes to be corked while the Pins are there. By theſe and the like Means it is probable, that further and further Improvements will, from time to time be made in the important Affair

of Ventilation, which well deſerves our moſt diligent Endeavours to bring to Perfection.

468. It is probable that two Setts of theſe Ventilators may be ſufficient for 20 Gun Ships, three Setts for 40 and 50 Gun Ships, ſix or eight Setts, with two Wind-mills, for 70, 80, 90, &c. Gun Ships: For a Ship of 1000 Tuns will not want as much more Ventilation as the *Sheerneſs*, a 20 Gun Ship, which is 500 Tuns: For though the ſolid Content of one is the double of the other, yet the Surface or Shell, if I may ſo call it, does not increaſe in ſo great, but much leſs Proportion: For though Spheres are to each other as the Cubes of their Diameters, yet their Surfaces are but as the Squares of their Diameters. And the Buſineſs of Ventilation is principally intended to preſerve the Shells of Ships. But as Wind-mills are ſubject to be becalmed near one-fourth of a Year, it will be the more adviſeable to have a redundant Quantity of Ventilation when the Wind-mill does work, that it may thereby the more effectually dry all Parts of the Ship; though freſh Air, whether damp or dry, will preſerve the Timbers much the longer from decaying. During long Calms the Ports, Gratings, and Hatches

may be opened, eſpecially at firſt, while the Ships are very damp. Whereſoever freſh Air can be conveyed among the Timbers, there they will not decay in many Years; which brings the Expence of Ventilation, even with eight Setts of Ventilators and two Windmills, to nothing in compariſon of the Value of the Savings thereby. This important Reſearch ought in Reaſon to be purſued to the utmoſt, the frequently changing the Air among the Timbers being the ſure and only Means of preſerving Ships much the longer from decaying. The *Prince*, a 90 Gun Ship, was compleatly ventilated in all Parts down to the Gun-deck, as appeared by holding a lighted Candle to the Seams: But the Ship received no Benefit below the Gun-deck; the Reaſon of which was, that the Seams of the Cieling of the Hold were all opened, which ought to have been caulked down to the loweſt proper Seam, which ought to be open all round the Hold, about half an Inch wide, for the ventilating Air to enter and paſs up among all the Timbers.

469. AND whereas it has been ſaid, that there ought to be no Ventilation in rainy Weather, leſt it ſhould make the Ship the

damper; in order to prove the contrary, I hung a wet Linnen Cloth under a Shed in my Garden,' which was open on all Sides; it had eight Ounces of Moiſture in it: Yet in 18 Hours almoſt continual Rain, ſeven Parts in eight of that Moiſture were dried off. And another time, when the ſame Cloth was hung there dry, it did not increaſe one Grain in Weight in 24 Hours Wind and Rain. Hence, even ſuppoſing a very damp State of the Air, with a good Wind, when a Ship is firſt cloſed up for Ventilation, it ſeems to me beſt to ventilate the Ship, notwithſtanding, in this Caſe, it will contribute very little to the drying it, for this Reaſon, *viz.* that a freſh damp Air being not putrid, will not deſtroy Timber, as a cloſe, confined, putrid, damp Air will do. This is evident to daily Obſervation, in the Caſe of the outſide Timber of Houſes, which continue ſound for more than 200 Years, though wetted by every Dew and Rain during that long Period. But ſuppoſing the Timbers of a Ship to be well dried by Ventilation, then it ſeems reaſonable not to ventilate a Ship in very damp States of the Air; for when once dry, probably very little Ventilation will ſuffice; though even in very dry States of the Air Ventilation will be uſeful.

And as to the Health of People at Sea, ſome Degree of Ventilation will be better for them than none; becauſe a hot, cloſe, confined, damp Air, loaded with the Vapours of the Crew, and of putrid Bilge-water, muſt needs be more unwholſome than a damp freſh Air. I hope, therefore, that theſe and many other ſtrong Reaſons which I have given, will effectually vindicate me in perſevering heartily and earneſtly to recommend this important Affair to the World. Experience will probably lead to further and further Improvements in the Methods of executing it.

470. IT is the juſt Obſervation of the ingenious Mr. *Cambridge*, that my Method for preſerving Ships from decaying does not, in any degree, diſqualify them for being ready to put to Sea, on ſhort Warning, and little Expence: And being on that account the more valuable, the real Merit or Demerit of the Propoſal ſhould therefore the more ſeduloufly be inquired into: If I am rightly informed, Ships in ordinary coſt at the Rate of ten Pounds a Gun to take out Planks, to prevent Decay, and replacing them again.

471. Mr. *Reid*, the Owner of the *Salterns* near *Portſmouth*, obſerves, that his Salt-ſhips are much preſerved from decaying, by the Acid of Salt. And the Timbers of the Hold of *Newfoundland* Ships are obſerved to be firmer than they naturally are, by means of the Salt of Salt-fiſh, the Acid of the Salt preſerving Timber as well as Fleſh, from Putrefaction. And I am informed that the *Dutch* have long practiſed the laying their Stores of Salt in Ships laid up in Ordinary, in order to preſerve them. And it has probably this good Effect, not only where the Salt actually touches the Ship, but alſo in more diſtant Parts, by the Influence of the acid Vapour which flies off from Salt; as may be ſeen in the Brick-walls of Rooms where Salt, or ſalted Proviſions are kept; which Walls are thereby corroded through to their Outſide; and this notwithſtanding the Salt does not touch thoſe Walls.

472. It is his ingenious Conjecture, that freſh Air contributes to preſerve Timber, not only by keeping it dry, but alſo by the acid Spirit in ſuch Air: Whereas a long, cloſe, confined Air, being deprived of a conſtant Supply of that acid Spirit, not only turns

putrid itſelf, but alſo greatly contributes to the putrefying of any adjoining Wood, *&c.* And this ſeems to be the probable Reaſon why, when freſh Air is admitted into an Ice-houſe, by opening the Doors to take out ſome Ice, then the Ice melts faſt; but when the Doors are cloſed again, ſo as to prevent the Entrance of freſh Air, ſtored with a new Supply of Acid, then the Degree of melting abates, in proportion as the laſt admitted Air is by the Ice in the Ice-houſe deprived of its acid Spirit. Thus common Salt mixed with pounded Ice, does, by virtue of its Acid, diſſolve the Ice faſt, and that even though the Cold is thereby, at the ſame time, increaſing to a very intenſe Degree for about ſeven Minutes; after which the intenſe Cold gradually abates. Mr. *Reid* therefore propoſes the putting Salt among the Timbers of Ships, as a Preſervative; and if the Salt be mixed among Oakham, not only the leſs Salt will ſuffice, but it will thereby be the better retained in all Parts among the Timbers. And as he obſerves in his Treatiſe on the Acid of Tar, that the *Finlanders*, by painting the Timber of their Houſes with this Acid, worked up with red Okre pulverized, make them laſt for 100 or 150 Years or more; and that dry Wood does not decay while it retains its acid Juice; for the drieſt Wood, if perfectly ſound, yields a great deal of it; but there is none in rotten Wood: He propoſes it, therefore, to be conſider'd, whether this Juice, prepared either with Copperas or Okre, or perhaps Verdigreaſe, may not preſerve Ships from rotting and worm-eating; as the acid Spirit of Vitriol with Copperas does. Hence it may be well to try whether the laying ſeaſoned Trunions, or other Wood, to ſoak in the acid Liquor of Tar, which is every where thrown away as uſeleſs, may not contribute to the longer Preſervation of Ships.

473. In order the better to preſerve Ships, ſuch as Bomb-veſſels and Merchant-ſhips, that do not continue long enough in Harbour to make it worth the while to have Ventilators, the following cheap and eaſy Method may be uſed, *viz.* to have a round Funnel of thin Boards, or old Canvas, or Tarpaulins, fixed at one End of the Ship through the upper and lower Decks, and reaching full half-way the Depth of the Hold; its Diameter to be about a Yard, or as wide as the Hatch-way will admit; with a Coul on the Top of this Funnel, turning with the Wind,

like thoſe on Malt-houſes, but with its open Part always towards and facing the Wind. And if it ſhall be found requiſite to obviate the Inconvenience of the Rains driving in at the Opening of the Coul, which always faces the Wind, it may eaſily be remedied, by placing at ſome Diſtance below the Bottom of the Funnel, a Piece of a Tarpaulin, in ſuch a ſloping Manner, as to receive and convey the Rain that falls on it, into a proper Veſſel. It will be very requiſite alſo to have another like Funnel and Coul, to paſs through the upper and lower Deck at the other End of the Ship; this Coul to have the open Part always turn from the Wind, as thoſe on Malt-houſes do: By this means there will be a very conſiderable Draught of Air paſs through the Ship, whenever the Wind blows from any Quarter; even as much when the Wind blows on the Sides as when on the Stern or Head in the common Way: A material Circumſtance, which the holding a lighted Candle when the Wind is ſide-ways in Ships, with and without Couls, will plainly ſhew. All the Hatches of the lower Decks muſt be ſhut, except the Hatch which is moſt diſtant from the Coul whoſe open Part faces the Wind, for by this means the whole Hold will be the more refreſhed: And it may probably be proper to have a Hole on the Side of the Funnel, through which the Air deſcends, for ſome of the freſher Air to paſs between Decks, if ſometimes all the Gratings are cloſed. This Method will probably be very ſerviceable to refreſh Mines. In order to ſhew the Reaſonableneſs of this Propoſal, I fixed a Box, a Foot ſquare within, on a Trunk nine Feet long, which was within equal to three ſquare Inches: This Trunk was fixed on the Eaſt Side of a Garden Wall, ſo as to have the Box three Feet above the Wall, with its Mouth ſideways facing the Weſt.

474. The Wind being then more than half a Storm full Weſt; when the Hand was held at the Bottom of the Trunk, the deſcending Air was very ſenſibly to be felt; and the Flame of a Candle was blown down to the Tallow, and extinguiſhed if turned round while held ſideways there. When a Glaſs Tube, near half an Inch diameter within, was fixed and cloſed in the Bottom of the Trunk, and the lower End of that Tube was immerſed a little way in Water, then, in the ſtrongeſt Guſts of the Wind, the Water

in the Tube deſcended about $\frac{1}{10}$th Inch, but not at all at other times. So the Force of the compreſſed Air was but $\frac{1}{10}$th of the Force of the ventilated Air in the *Sheerneſs*, where the Water deſcended an Inch at each Stroke of the Ventilators. Therefore, this Method would be inſufficient to drive plenty of Air among the Ribs: But yet, by this means 27 times more freſh Air might be conveyed into a Ship in ordinary, than can be done by the four Fire-pipes, as I found by Calculation, and this without the Expence of Fire.

475. As in diſtilling ſtinking Sea-water, I obſerved the ſtinking, putrid Parts of the Water to riſe firſt, leaving the remaining Water ſweet; ſo the Volatility of the moſt putrefying Vapours, ſhews the Reaſon why Ships are moſt ſubject to decay under the Cells of the Port-holes, where the higher Aſcent of theſe Vapours is ſtopped; where, by their Stagnation, they remain, and by way of Fermentation rot the Timber, the Sap of which is very ſubject to Putrefaction; as is evident by the known Effect of the Sap of a green, unſeaſoned Pump's cauſing the Water of a Well to ſtink; which is alſo the Reaſon why Ships built of green, ſappy Timber, are

always very unhealthy, its putrefying ſappy Vapour, mixed with the putrid Vapour of the Bilge-water in the Hold, and the putrid Perſpiration of the Men, greatly promoting the Putrefaction of the cloſe confined Air between Decks; which Inconvenience will effectually be prevented by Ventilation; which I mention Vol. I. Numb. 44.

476. WHERE the Earth under the Ground-floors of Houſes is damp, and, cloſe confined, it not only rots in a few Years the Joyce and Boards of the Floors, but alſo, by its aſcending putrid Vapour, the very Wainſcot of thoſe Rooms, as it does the upper Works of Ships: Whereas, when the Earth under Ground-floors is dry, they do not rot, notwithſtanding the Air is cloſe confined under thoſe Floors: Which both ſhews the Reaſon why the Timbers of Ships are ſo apt to rot, where there is a damp, cloſe, confined Air; and alſo the great Importance of changing that Air often, by plentiful Ventilation, and thereby drying thoſe damp Places, which will doubtleſs contribute much to the longer preſerving of thoſe Timbers. And whereas a damp, ſtagnant, cloſe, confined Air, is well known to rot Timber much faſter than a

damp freſh Air; this ſhews the Reaſonableneſs of ventilating Ships in ordinary, even in damp States of the Air. And whereas Men are very liable to Diſtempers from moiſt, corrupt Air in Ships, eſpecially in long ſtormy Weather, when Hatches, Ports, and Gratings are cloſed; it is for the ſame Reaſon beſt to ventilate the Ship, even in damp Weather, *viz.* becauſe a damp freſh Air is not ſo very unwholſome as a damp, cloſe, confined Air.

477. THE Owners of the Horſe-ferry Boats at *Richmond* and *Kew*, complaining to me that the thick Fir Planks of their Floors were ſubject to decay and rot in a few Years; and I obſerving that they were ſo cloſe that no freſh Air could get in: I propoſed to them the free Admittance of freſh Air; which they did by cutting away thoſe Parts of the Floor on each Side, which were between the upright Timbers or Ribs; to which they nailed thin Fir Boards about five Inches broad, to prevent the falling of Dirt under the Floor. By this means the freſh Air has a free Admittance under the Floor, as is evident by holding a Piece of Paper, or Handkerchief, over any one of the Air-holes between the Ribs, on one Side of the Boat, when the

Wind blows againſt the Inſide of the oppoſite Side, when the Paper will be blown upwards; and, *vice verſa*, downwards, if the Paper, *&c.* be held in like manner on the oppoſite Side: a plain Proof that the freſh Air paſſes freely under the Floor of the Boat; which will doubtleſs preſerve it many Years the longer from decaying: When the Water has been laded out, the freſh Air has dried up the remaining Damp under the Floor.

478. Besides the common Motives of Humanity to uſe our beſt Endeavours for preſerving the Health and Lives of Mankind, there are ſome peculiar to this unhappy Age; in order to counter-ballance, in ſome meaſure at leaſt, the aſtoniſhing Havock and Deſtruction that is made of the Lives and Morals of Mankind, over a great Part of the World; occaſioned by fermented diſtilled ſpirituous Liquors, which even debaſe the Breed of Man: An Evil ſo amazingly great, that did not woful Experience too fully prove it, it would ſeem incredible to believe, that any whom it concerns, could poſſibly be ſo negligent, as not to uſe their utmoſt Endeavours to ſuppreſs that deſtructive *Man-Bane.*

479. IT is the juſt Obſervation of Dean *Conybeare*, in his Sermon on the Thankſgiving-day for the Peace, 1749, *viz.* "Here "then the true Lover of his Country has a "noble Field of Action; and he is ſo much "the more concerned to attend to this Point, "becauſe the Decay of Morals in this preſent "Age is notorious: Vices to which Men "heretofore were tempted only by Affluence, "are now derived down to the loweſt Part "of the People; ſo that thoſe in whoſe "Virtue and Diligence heretofore conſiſted "the main Strength of the whole, are now "become more and more a Burthen. The "Conſequence of this is dreadful, and there"fore the Concern to prevent it muſt be "obvious."

480. AS there is an Abatement of one-third of the *Britiſh* Diſtillery, by reaſon of the Exciſe laid on thoſe Spirits, ſo it is a good Omen that an effectual Reſtraint will be laid on thoſe moſt deſtructive Liquors. How humane and laudable an Example will this be to thoſe other Nations of the World, where this greateſt of all Evils that ever befel unhappy Man, makes an uncontrolled, amazing

Havock of the Lives and Morals of Mankind.

481. THAT eminent Phyſician Dr. *Hoffman*, in his ſeven Rules for preſerving Health, expreſsly cautions againſt the Uſe of diſtilled ſpirituous Liquors: "Becauſe, he ſays, they "are above all Things moſt unwholſome; "becauſe cauſtick burning Spirits, by inflaming the Solids, and coagulating and "thickening the Fluids, cauſe Obſtructions, "which bring on many fatal Diſeaſes; ſuch "as Hectick Fevers, Jaundices, Dropſies, "*&c.* whereby Multitudes are daily and "yearly deſtroyed. And alſo that they rot "the Intrails, ſuch as the Liver, Stomach "and Bowels; as is evident, he obſerves, not "only by opening the Bodies of thoſe who "are killed by drinking them, but alſo by "what is obſerved in *Germany*, of the Effects which the cauſtick, fiery, remaining "Waſh of Diſtillers has on the Guts of "Hogs, which are thereby ſo rotted, that "they cannot make Hogs Puddings with "them." And to the ſame Cauſe, together with the greater Quantity of Liquor which they ſwill down, it is doubtleſs owing, that the Bladders of ſuch Hogs are much larger

than thoſe of other Hogs, *viz.* becauſe being tender, they more eaſily diſtend in blowing up: And the whole Fleſh of ſuch Hogs is ſo much tenderer, that it will not keep by ſalting, ſo well as the Fleſh of other Hogs will do.

482. It is the known Obſervation of Dealers in Hair for Wigs, that they can diſtinguiſh the Dram-drinker's Hair by the Touch, finding it dry, harſh, dead-ended, and unfit for Uſe. And in the ſame manner it is, that it ſpoils the Stomach and Bowels, the Liver and Lungs, and the whole Body of thoſe unhappy Perſons.

483. And it is very obſervable, that theſe pernicious diſtilled Spirits not only hurt the Bodies, but ſpoil the Tempers even of Hogs; for it is a known Obſervation, that if a Diſtiller's Hog cries out with the Voice of Diſtreſs, the other Hogs will fall on him and deſtroy him, if he is not immediately taken from them; whereas it is well known, that the Farmers Hogs are zealous in defending each other, when they cry out in Diſtreſs.

484. And diſtilled Spirits have the ſame bad Effect in depraving the Tempers of Mankind, by heightening their Paſſions, or making them perverſe and croſs: They tend greatly alſo to the depraving of their Morals, by quenching the Spirit of Religion to ſuch a Degree, as to make them prophane and abandon'd, as to all Senſe of Duty to God and Man; as alſo wholly regardleſs, either of their own preſent temporal, or future eternal Welfare and Happineſs. Thus, not only their temporal bodily Health is irreparably depraved to ſuch a degree, as that, by the concurring Teſtimony of all Phyſicians, it cannot be reſtored; for Medicines have no healing Efficacy on ſuch; but what is infinitely worſe, and an aſtoniſhing Conſideration, their Souls are debaſed and ſunk at ſo vaſt a Diſtance from all the healing Influences of Religion, that they have no Senſe of, nor Longings after, *the Fountain of ever-living Waters:* For human Nature is ſo exceſſively debaſed by diſtilled ſpirituous Liquors, that it would be no inconſiderable Degree of Happineſs to be raiſed thence, even no farther than to the low State and Condition of brute Creatures: For it is an unjuſt and diſparaging Compariſon, even to the brute Beaſts, to compare an ha-

bitually drunken Dramiſt to thoſe ſober, temperate Creatures, who have a ſtrong natural Affection for their Young-ones, which is notoriouſly extinguiſhed in Dramiſts. God, who has curiouſly wrought our wonderful Frame out of the Duſt, knowing how prone we are to diſorder it by Irregularities, of his tender fatherly Care for us, has not only implanted in us a ſtrong Deſire of Life and Self-preſervation, but has alſo ſtrictly enjoined us to avoid all deſtructive Irregularities and Vices, and the Practice of thoſe Virtues which are ſo well adapted to our Nature, that they have a natural Tendency not only to keep the Body in Order, but alſo to give *Health to the Soul*, as well as *Marrow to the Bones*, Prov. iii. 8. Yet how is this delicate, this curiouſly wrought Frame, often abuſed and diſordered, by repeated Irregularities of many kinds: But never before to the enormous Degree that it has of late Years arrived at, by the exceſſive Abuſe of that *Bane of human Nature, fermented diſtilled ſpirituous Liquors:* Which, by their miſchievous Effects, ſeem to claim *Satan* himſelf for their Author.

485. THE unhappy Dram-drinkers are ſo abſolutely bound in Slavery to theſe infernal

Spirits, that they ſeem to have loſt the Power of delivering themſelves from this worſt of Bondage, which they have unhappily brought themſelves into. How much then is it the bounden Duty of thoſe who have it in their Power, to with-hold, and not hold forth, this deſtructive *Man-bane*, to the People committed to their Charge.

486. DR. *Cheyne*, in his *Eſſay of Health and long Life*, ſays, "All People who have "any Regard to their Health and Lives, ought "to tremble at the firſt Cravings for ſuch "poiſonous Liquors: The Maladies begot "by them bring forth Neceſſity upon Ne-"ceſſity of Drams and Jills, till at laſt a "kind Dropſy, nervous Convulſion, a ner-"vous Conſumption, or colliquative Diar-"rhœa, or Flux, if not a Fever or Phrenzy, "ſets the poor Soul free. It is obſerved, "that many mad People have been great "Drinkers of Drams, theſe fiery Spirits de-"ſtroying the very tender Fibres of the "Brain.

487. "DID this bewitching Poiſon actually "cure, or relieve them from time to time, "ſomething might be ſaid to extenuate the

" Folly and Phrenzy of ſuch a Courſe; but, " on the contrary, it heightens and enrages " all their Symptoms and Sufferings ever afterwards, excepting the few Moments after " taking it down; and every Dram begets " the Neceſſity of two more to cure the ill " Effects of the firſt."

488. DR. *Short*, in his *Hiſtory of Mineral Waters*, p. 225, ſays, " The oftener I reflect " on the Miſchief done by diſtilled Spirits, " the more I am confirmed that the human " Race had been happier had Drams never " been known, and cannot help cordially " joining with Dr. *Allen*, *Synopſis Medicin.* " Article 1633, " that the plentiful devouring of thoſe Spirits, has killed as many " Thouſands of Men as there are Stars in the " Sky. Nay ten times ten thouſand have " died by theſe more than all the reſt of the " Poiſons whatever. Wherefore, if ſuch " Spirits deſerve not the Name of Poiſon, he " neither can learn nor conjecture by what " elſe they ſhould be called; for, taken inwardly, they are detrimental to almoſt all " Animals."

489. Dr. *Linde*, in his elaborate and ingenious Treatiſe on the Scurvy, ſays, That he obſerved that moſt deſtructive Diſtemper to be much increaſed, even to Mortality, by diſtilled ſpirituous Liquors, which Sailors are too apt greedily to ſwallow down. To prevent the ill Conſequences of which, Admiral *Vernon*, in his Expedition to take *Porto-bello*, very prudently mixed a good Proportion of Water with the ſpirituous Liquors, which had the deſired good Effect on the Health and Lives of his Sailors. And Captain *Ellis* attributes to the ſame wiſe Precaution, the uncommon Succeſs he had, in bringing home, in the Years 1753 and 1755, all his white Men, which were 34 and 36, in Health, from a *Guinea* Voyage of 15 Months. And it is with Pleaſure that I hear, that it is now become a more and more general Practice at Sea, to mix Water with the diſtilled ſpirituous Liquors of all kinds: Which it is therefore the bounden Duty of all Commanders of Veſſels to do, who have any Value, any Bowels of Compaſſion for the Health and Lives of their Sailors. In our royal Navy all diſtilled Spirits are forbid, and Wine wiſely provided.

490. AND the like good Effect has of late Years been found at Land, in our Colonies in *America*, by mixing a much greater Proportion of Water with the Rum; whereby it is happily found to be more ſalutary: For when the Punch was ſtronger, it deſtroyed many. Which great Degree of Unhealthineſs, as I well remember, was then attributed to the Lime-juice, being loth to accuſe their too-well-beloved Rum of ſuch pernicious Effects: But are now happily convinced by Experience, that the weaker the Punch, ſo much the more wholſome it is.

491. AND ought not this in reaſon to rouſe all the Nations of the World to be in Earneſt; for they have nothing more to do than to prevail with themſelves to be in Earneſt, in order effectually to put the ſame ſalutary Method in practice at Land. The cold, ſleepy Reaſons that have hitherto prevailed, to the countenancing of the contrary moſt deſtructive Practice, ought ſurely to be rejected with Scorn and Indignation, in a Caſe wherein the Welfare of Millions of Mankind is ſo deeply concerned: What Multitudes of Lives would thereby be ſaved, and innumerable Outrages,

as Thefts, Murders, &c. prevented! To rectify which were, doubtleſs, a moſt apparently vain and fruitleſs Attempt, while Drunkenneſs is made the cheapeſt of all Vices: For theſe intoxicating, peſtilent Drams, not only deſtroy the Health and Lives of Multitudes over the World, but alſo greatly tend to deprave and debaſe the human Species to ſuch a degree, as abſolutely to quench all Senſe of Duty to God or Man, and all Power and Inclination to diſcharge the neceſſary Offices of ſocial Life. It is therefore to be hoped, that the Nations of the World will no longer be infatuated by this inchanting Siren, but in earneſt rouſe themſelves to find an effectual Remedy for this epidemical Plague.

492. An eminent Surgeon informs me, that he has obſerved the Stomachs of great Dram-drinkers to be contracted into half the common natural Size, and to be hard, ſomewhat like Leather that has been held to the Fire: The Conſequence of which is, Loſs of Appetite, and a waſting Conſumption.

493. And accordingly I have found, by putting raw Fleſh into ſeveral Sorts of diſtilled Spirits, *viz.* Brandy, Rum, Arrack, and Gin,

that they all in like manner harden Fleſh, by their pernicious, burning, cauſtick Salts, which are made ſuch by the Action of Fire on them in Diſtillation, in the ſame manner as Salt-petre, from a mild, wholſome Subſtance, is, by the Action of Fire in Diſtillation, made *Aqua Fortis*, one of the rankeſt Poiſons, its Salts being thereby formed into Darts and Spears, which tear not only animal Subſtances in Pieces, but alſo the hardeſt and moſt ſolid Metals: Accordingly I have been informed by Diſtillers here, and by Planters in *America*, that the more of the Action of Fire theſe Spirits have undergone in Diſtillation, ſo much the more corroſive and unwholſome they are; which is remarkably true of the later Diſtillations of Rum, called low Wines, which kill many of their Poor, and of the Slaves, who drink them on account of their Cheapneſs. Arrack is alſo very deſtructive in the *Eaſt-Indies*.

494. It appears from Admiral *Knowles*'s Orders to reſtrain the Uſe of Rum at *Cape-Briton*, which I have ſeen, that they got drunk with it at the rate of a thouſand a Day, and that 1400 *New-England* Men were, in two Months, killed by it.

495. THE *Baron de la Honton*, in his Travels, Vol. II. Page 147. *French* Edition, ſays, "That diſtilled ſpirituous Liquors make "terrible Havock among the People of *Ca-* "*nada*; for the Number of thoſe that drink "it far exceeds that of thoſe who abſtain "from it. The Havock and Deſtruction "which it makes among them is ſo inex- "preſſibly great, that it will exceed the Be- "lief of all who are not Eye-witneſſes of it. "It extinguiſhes their natural Heat, and "makes them languid, ſpiritleſs, and con- "ſumptive: They look pale, livid, and "frightful as Skeletons."

496. Governor *Belcher*'s Lady, of *New-Jerſey*, wrote me, that Rum being very cheap there, the People are ſo attached to it, that in Harveſt-time they make it their Bargain to have every Man a Pint a Day, beſides Wages.

497. DR. *Watts*, in his Book on Self-murder, ſays, that the Inſcription on Dram-drinkers Graves ſhould be, *Here lies a Self-murderer*.

498. NOTWITHSTANDING the Deſtructiveneſs of theſe diſtilled ſpirituous Liquors is ſo notorious, that not only every open willing Eye, but even the wilfully Blind, cannot but ſee the Miſeries that they bring on Mankind; yet how does this inchanting *Siren* bewitch and infatuate the Nations of the Earth with its Sorceries, inſomuch that Multitudes of unexperienced freſh Dram-drinkers are daily crowding on to taſte of the invenomed Cup. And will not this Infatuation of the Nations, in all Probability, greatly tend to haſten, with an accelerated Speed, the filling up of the meaſure of the Iniquity of the *Gentiles*?

499. IT is pretended that Drams comfort, warm and defend from the ſevere Cold to which Men are ſometimes expoſed, without which, they ſay, they ſhould periſh with Cold; which is probably, in a great meaſure, true of thoſe who are much habituated to drink them: The Blood of ſuch being thereby ſo much impoveriſhed, that it is well known many of the habitual Drinkers of Drams are cold and lifeleſs in the midſt of Summer, without frequent freſh Draughts of it; this is what ſome of them have owned to me. But, on the other hand, how much abler are ſober

Perſons to endure Cold and Hardſhips! Their vital Heat, not being extinguiſhed with Intemperance, does by its kindly genial Warmth, more effectually ſecure them from the Inclemency of Weather, than the falſe Flaſh of that which a Dram gives. Beſides, it is well known that Men did not periſh in the coldeſt Countries for want of Drams formerly, when they were not to be had. Of the undoubted Truth of this Captain *Ellis* gives a full Proof, in the Account of his Voyage to *Hudſon*'s Bay, Page 199. Where he obſerves, That the Natives on the very cold Coaſt of that Bay, to whom the *French* are kinder than to ſell diſtilled ſpirituous Liquors, are tall, hardy, robuſt, and active: "Whereas thoſe of them "that are ſupplied with Drams from the "*Engliſh*, are meagre, dwarfiſh, indolent "People, hardly equal to the Severity of the "Country, and ſubject to many Diſorders."

500. AND as to the pernicious Effects of ſpirituous Liquors in very hot Climates, as on the Coaſt of *Guinea*, it is obſerved, that the *French* and *Portugueſe*, who do not indulge in diſtilled Spirits, are very healthy there; but that the *Engliſh*, who drink Spirits, die faſt. Thus alſo it is obſerved of

the *Women* in *Barbados* and *Jamaica*, that being ſober they live long; but it is not ſo with the *Men*, who are more generally intemperate.

501. SINCE then the Evil is become ſo notoriouſly epidemical, as to debilitate and deſtroy Multitudes in moſt Parts of the World, how deſtructive muſt it be to the real Welfare of thoſe Nations where it rages! It behoves therefore all who have any Bowels of Pity for their Fellow-creatures, to do their beſt to deliver them from it. Such weighty Conſiderations ought therefore, in all reaſon, to rouſe the Governors of the Nations, as tender Fathers, to uſe their utmoſt Endeavours to deliver the People committed to their Charge, from this mighty Deſtroyer. Can there be any Conſiderations of ſufficient Weight to the contrary? Is it ſound Policy to encourage Vice in the People becauſe a preſent Revenue ariſes from their Debauchery? Where will the Revenues be, when the People, who ſhould pay them, are deſtroyed? Are not a hardy, induſtrious, healthy People always found to be the ableſt to contribute amply to the Support of Government? And will not Temperance, in the End, be found

a more effectual Means to increaſe the real Wealth and Strength of a Nation, than to make Drunkenneſs the cheapeſt of all Vices? A Vice which can no otherwiſe be effectually prevented from raging with its preſent exceſſive Enormity, and ſpreading Devaſtation all around, but by making it ſo expenſive as to put it abſolutely out of the Reach of the great Number of inſatiable thirſty Dramiſts, or ſo weak as to be leſs hurtful.

502. It is well known that many of thoſe who keep publick Houſes ſhorten their Lives by intemperate drinking: The common Plea for which is, that they are obliged to do it, in order to get a Livelihood; or, in other Words, to kill themſelves in order to live. And is not this the very Caſe of thoſe Governments who debilitate and deſtroy the Strength and Vitals of a Nation, in order to be Gainers by this national Temptation to *do Evil, that Good may come of it.*

503. But if the Conſideration of the Inhumanity of being inſtrumental to the Deſtruction of Multitudes, and in a manner, in ſome Parts of the World, of whole Nations, is not of Weight enough to influence; yet

ſure the awful Conſideration that it muſt needs be highly diſpleaſing to our merciful Creator, to have his favourite Creature Man thus debaſed, diſgraced and deſtroyed, both in Body and Soul, ought to have its due Weight. Can it in reaſon be expected, that he will always ſtand by an unconcern'd Spectator of ſuch aſtoniſhing Proceedings? And will he not in Mercy viſit the Nations for theſe Things, to prevent the ſtill much greater Ruin of future Generations; in conformity to God's uſual Methods of Proceeding, when Irregularities are arrived to great Exceſs. And this Diſeaſe is now arrived to ſo enormous a Pitch, that 'tis much to be feared, nothing leſs than his ſevere fatherly Correction, will effectually cure it in many of the Nations; who ſeem as ſupine and unconcerned about it, as if only ſo many Thouſands of Chafers or Locuſts were deſtroyed thereby: For if in 50 or 60 Years this deſtructive *Peſt* has ſpread thus far and wide, how vaſtly greater will the Havock among Mankind be in an hundred Years more, if ſome Check be not put to its Career.

504. IF it had been ſaid an hundred Years ago to any of the Rulers of the Nations, that they ſhould patiently, and even unconcernedly

ſee ſuch Multitudes of their Subjects deſtroyed, both Body and Soul, and that only for ſordid Lucre, would they not with Indignation have ſaid, as *Hazael* did to *Eliſha*, 2 *Kings* viii. 13. *But what! is thy Servant a Dog, that he ſhould do this great Thing?* The plain Truth is, that it is with Nations as it frequently happens to private Perſons, that when they grow gradually from bad to worſe, they at the ſame time grow more and more hardened, ſo as to be even reconciled to Practices for which they had at firſt the utmoſt Deteſtation and Abhorrence; for Familiarity takes away our Attention, and robs things of their Power to ſtrike ſtrong upon us.

505. Though Thouſands and ten Thouſands periſh yearly by Drams, *yet no Man layeth it to Heart*, except the Heads of the poor wild *Indians* and *Mohawks*, near *New-England*, *New-York*, *Virginia*, and other Parts of *North-America*; who being ſenſible of the great Deſtruction made among them, by diſtilled ſpirituous Liquors, have long ſince, and do ſtill continue earneſtly to deſire that no Rum ſhould be ſold to their People. I am credibly informed, that it is no uncommon Thing in *North-America* for habitual Dram-

iſts,

iſts, when Sickneſs comes on them, concluding it will be their laſt Illneſs, to deſire to have plenty of Rum by them, that they may continue till Death in an intoxicated Condition; to ſo aſtoniſhingly deplorable a ſottiſh Condition have they reduced themſelves, by habitually indulging in this Man-bane. Alas! how aſtoniſhing a Calamity is this, which is vaſtly greater than the Sum total of all the other Miſeries that ever befel unhappy Man: It being both a moral and a natural Evil; both debaſing and depraving the Morals, and ſhortening and deſtroying the Lives of Multitudes, probably not leſs than a Million yearly all over the World; notwithſtanding which, this enchanting Liquor ſo infatuates the Nations, that nothing leſs than an extraordinary Hand of Providence can deliver Mankind from this favourite, much-beloved, mighty Deſtroyer. Were but one-fourth of this Number yearly deſtroyed by raging Peſtilence, with what earneſt, ingemminated Supplications, would Mankind deprecate ſo terrifying and ſore an Affliction. How ſevere a Judgment is it when God leaves Men to be their own Scourgers! with how unrelenting and unmerciful a Heart do they perpetrate an Evil that ought to be de-

deprecated both in publick and private, with ingemminated Petitions!

506. Thus much Neceſſity has urged me to ſpeak, in a caſe ſo calamitous to Mankind, that to have a thorough Senſe of it, and yet not to remonſtrate, nor earneſtly precaution againſt it, were ſure as criminal as not friendly to warn a precipitate or blind Perſon of a dangerous Precipice or Pit. Yet, alas! how unconcerned are the greateſt Part of Mankind at this moſt enormous Ruin of Multitudes, in many Nations of the World. Thus, in *Ruſſia*, a vaſt Revenue is raiſed from diſtilled ſpirituous Liquors, and a proportionably immenſe Multitude of People are deſtroyed thereby.

507. As this greatly intereſting Affair requires the exerting the utmoſt Efforts to rouſe the Attention of Mankind to the ſerious Conſideration of it, I ſhall here add an Extract from a printed *Addreſs to an eminent Perſon, upon an important Subject*, viz. "Aſk thoſe
" in Stations of Power and Truſt, aſk them
" if they can look with Indifference upon
" their poor diſtracted Countrymen, who are
" poiſoning and deſtroying themſelves? In
" Trials for Life, what Diligence is not uſed

" to

“ to find the Truth, on occaſion of the Loſs
“ of one Subject? What Care will not a
“ faithful Phyſician beſtow for the Preſervation
“ of one Life? How did the wiſe *Romans*
“ honour him who ſaved the Life of
“ one *Roman* Citizen? But in the preſent
“ Caſe, it is not one, nor one hundred, nor
“ one thouſand, but many thouſands of Lives,
“ probably not leſs than a Million, that periſh
“ yearly over the World, by this worſt of
“ Peſts.—How then dare the Governors of
“ the Nations be ſilent or unconcern’d in a
“ Cauſe in which Humanity, Virtue, the
“ Proſperity of Mankind, and Religion, are
“ ſo deeply concerned? for whatever tends
“ not only to the weakening the Faculties,
“ enervating the Bodies, and of courſe, diminiſhing
“ the Induſtry of Labourers and
“ Artificers of both Sexes, but alſo to the preventing
“ the Birth of thouſands, deſtroying
“ many Infants, to the greatly debaſing the
“ Breed of Man, and ſhortening the Lives of
“ Multitudes. Whatever produces Effects
“ of theſe Kinds, muſt bring irretrievable and
“ final Ruin on thoſe unhappy Nations where
“ this deſtructive Peſt rages. Ought not
“ then a Stop to be put to this dreadful Calamity,
“ before it be too late, *by any Means,*

" *and upon any Terms whatſoever*, in thoſe
" Nations where they mean to keep up any
" Face of Government? Nor can there be
" any Inconvenience like to ariſe from the
" Redreſs of the Grievance, that deſerves to
" be named with thoſe Evils which muſt be
" the undoubted Conſequences of its Continuance."

508. IF all theſe weighty Reaſons will not rouſe a careleſs World into a Senſe of Self-preſervation, enough to put Men upon avoiding ſo certain and terrible a Deſtruction, they are then ſurely under a ſtrong Deluſion and Infatuation, and conſequently abandoned to ſuffer the ſevere Puniſhment, of reaping the unhappy Fruits of their own perverſe Ways. The calamitous Urgency of the Caſe abſolutely requires the moſt pathetical Expoſtulations, to rouſe the Attention and Indignation of Mankind againſt this greateſt of all Plagues that ever befel unhappy Man; it being both our Sin, and the ſevereſt of Puniſhments, which Mankind have moſt ſenſeleſly inflicted on themſelves.

509. A VERY eminent Phyſician, of great Knowledge and Experience, has given the fol-

lowing Directions, for the Benefit of thoſe who have Wiſdom and Virtue enough left to abandon the odious and pernicious Practice of drinking diſtilled ſpirituous Liquors, *viz.*

510. " ONE of the beſt Ways of leaving
" off the bad habit of drinking Drams is, by
" degrees to mix Water with the Drams, to
" leſſen the Quantity of the Dram every
" Day, and keep to the ſame Quantity of
" Water, till in about the courſe of a Week,
" nothing of the Dram-kind be uſed along
" with the Water. By this means the Per-
" ſon will ſuffer no Inconvenience, but reap
" great Benefit upon leaving off Drams; as
" has been tried by many.

511. " If any Gnawing be left in the Sto-
" mach upon leaving off Drams, a little hot
" Broth is a very good Remedy.

512. " THE Appetite always increaſes in
" a few Days after leaving off Drams, unleſs
" by the too long Continuance of them, the
" Tone of the Stomach is deſtroyed.

513. " IN which melancholy State, the beſt
" Remedy, next to the *Bath* Water, is the
" fol-

“ following, *viz.* Take an Ounce of *Elixir*
“ *Proprietatis*, three Drams of *Elixir of Vitriol*, and one Dram of *Minſicht*'s *Elixir of*
“ *Steel*; mix theſe together, and let the un-
“ happy Sufferer take a Tea-ſpoonful in a
“ ſmall Wine-glaſs, full of White-wine, if
“ that can be afforded, or elſe *Wormwood Ale*,
“ or a Cup of Carduus or Camomile Tea,
“ every Morning faſting, and every Evening.”

514. I SHALL here add a Panegyrick on Temperance, from Dr. *Short*'s *Hiſtory of Mineral Waters*, Page 9. a Panegyrick worthy to be recorded in every one's Memory, *viz.*
“ O Temperance! thou Support and Atten-
“ dant of other Virtues! thou Preſerver and
“ Reſtorer of Health, and Protractor of Life!
“ thou Maintainer of the Dignity of rational
“ Beings from the wretched, inhuman Sla-
“ very of Senſuality, Taſte, Cuſtom, and Ex-
“ ample! thou Brightener of the Under-
“ ſtanding and Memory! thou Sweetener of
“ Life and all its Comforts! thou Companion
“ of Reaſon, and Guard of the Paſſions!
“ thou bountiful Rewarder of thy Admirers
“ and Followers! How do thine Excellencies
“ extort the unwilling Commendations of
“ thine Enemies! And with what rapturous
“ Pleaſure

"Pleaſure can thy Friends raiſe up a Panegy-"rick in thy Praiſe!"

515. VENTILATORS will probably be of good Service for preſerving Herring-nets in ſtormy Weather, when they are obliged to ſtow the wet Nets in Heaps in the Ship, which cauſes them to decay much: Which Inconvenience may, in a good meaſure, be prevented by blowing ſeveral Times in a Day, freſh Air up through them, through very ſmall Air-trunks placed on the Floor, at three or four Feet diſtance, with their four Seams opened about a Quarter of an Inch; the freſh Air to be blown in by a ſmall Ventilator, about the Size of that Fig. 6.

516. AND in the ſame manner the Nets may moſt effectually be preſerved much the longer from decaying in the Store-houſes, by ſuch large double Ventilators as are in *Newgate*, worked by a Wind-mill. And as they may be laid of any Depth on the Air-trunks, on the Floor, much leſs Expence of Store-houſe-room will do. Perhaps it may be adviſeable to have Layers of Hurdles, or ſmall Faggots, every three or four Feet, among the

Layers of Nets, to give a free Paſſage for the Air upwards.

517. THERE is a common Fault in moſt Pigeon-houſes, *viz.* that the freſh Air is admitted to enter only at the upper Part of the Roof; by which means the foul, fœtid Vapours of a great Quantity of Dung, and the perſpiring Matter from great Numbers of them, being too cloſe confined, putrifies and incommodes both the Hatching and Thriving of Pigeons. Monſ. *de Reaumeur* obſerves, in his Treatiſe on hatching of common Hen-eggs, that if the foul Wreak of the Dung, by the Warmth of which they were to be hatched, came at the Eggs, then they would not hatch. Now this Inconvenience may be prevented by making Holes in the Side-walls, at ſuch a Height, that Men or Cattle going by ſhall not fright them; or by Holes in the Walls ſlanting upwards, or a Board within, at a ſmall Diſtance oppoſite to the Hole.

518. DR. *Langriſh*, of *Wincheſter*, uſed this Method to a new-built Pigeon-houſe at *Petersfield*; where Pigeons did not breed till Air-holes were made in the Side-walls: And I have known ſeveral Inſtances of Pigeon-

houſes, where they have bred more, and have thrived the better for having freſh Air admitted through the Walls. Nor need any be apprehenſive leſt by this means, the Pigeons ſhould be expoſed to too much cold: It is well known that tame Pigeons thrive very well in their Neſts on the Outſide of Houſes, where they are expoſed to much greater Degrees of Cold, and inclement Air.

519. In order to preſerve great Quantities of Corn in large Granaries, it may very commodiouſly be done in the following Manner, *viz.* by fixing large double Ventilators, laid on each other, at the Middle and near the Top of the Granary, that they may be worked by a Wind-mill fixed on the Roof of the Granary: But a Water-mill will be much better, becauſe it will work the Ventilators more conſtantly. The Air to be conveyed from the Ventilators through a large Trunk or Trunks, reaching down through the ſeveral Floors to the Bottom of the Granary, with branching Trunks to each Floor, to convey the Air into a large Trunk along the adjoining Croſs-walls; from which Trunks ſeveral leſſer Trunks, about four Inches wide, are to branch off, at the Diſtance of three or four

Feet from each other, which are to reach the whole Length of the Granary, and are to have their farther Ends cloſed; Seams of one-tenth or one-twelfth of an Inch, are to be left open at the four Joinings of the Boards, where they are nailed together, for the Air to paſs through among the Corn, putting ſmall Slices of Wood in, or old Sole-leather, at proper Diſtances, to keep the Seams open. The Trunks which are next to the Side-walls ought to be ſomething nearer to the Walls than they are to the next adjoining Trunks, that the Corn next the Walls may have its due Proportion of Ventilation. But if the Corn does not lay againſt the Side-walls, then only one, or very few of thoſe ſmaller Trunks will ſuffice, more or leſs, in proportion to the Breadth of the Granary; and they may in this Caſe be the more diſtant from each other. Mr. *Yeoman* has by Experience found this a good Method to preſerve Corn.

520. AND as all the ſmall Trunks of a Granary will not probably be covered with Corn at once, ſo it will be proper to have ſliding Shutters to each of theſe leſſer Trunks, where they branch off from the larger Trunk, in order to ſtop the Paſſage of the Air through

the Trunks which are not cover'd with Corn; or in caſe all are cover'd with Corn, to ventilate the more briſkly one Part of the Granary which may want it more than the other; in order to which, it will be requiſite to have long Rods, reaching to the Sides or above the Corn, fixed to the ſliding Shutters.

521. THERE muſt be woodon Shutters hung on Hinges at their upper Part, ſo as to ſhut cloſe of themſelves; theſe muſt be fixed to the Openings in the Walls of the Granary, on their Outſide: By this means they will readily open, to give a free Paſſage for the ventilating Air which aſcends through the Corn, to paſs off, but will inſtantly ſhut when the Ventilation ceaſes, and thereby prevent any Dampneſs of the external Air from entering: For which Reaſon the Ventilation ought to be only in the middle of dry Days, unleſs the Corn, when firſt put in, is cold and damp.

522. I LAID a long Trunk on a Barn-floor, about five Inches wide in the Clear within; the four Seams were about one-tenth Inch wide, for the Air to paſs through the whole Length, the further End being cloſed; a

large Heap of Corn was laid on it, through all Parts of which the Air from the ſmall Ventilators, (*Fig*. 6.) paſſed freely; as was evident by the Motion of a light-ſpread Handkerchief laid on any Part of it. This ſeems, therefore, to be a commodious and cheap Method to ventilate Corn in large Granaries, *viz.* by laying ſuch a Trunk on the middle of the Floor, the whole Length of the Granary; and if the Granary is very long, it will be well to have the Air from the Ventilators enter the Trunk at its Middle; by which means either the whole Granary, or but one-half of it, may be ventilated at a time. But in this Method of ventilating with one Trunk, the Corn muſt not lay againſt the Side-walls, which would prevent the free Paſſage of the Air ſide-ways. But if in Granaries already built, at a little Diſtance from the Side-walls, a lattiſe upright Fence, about five Feet high, is fixed; this Fence to be lined with looſe wove Hair-cloth, for the Air to paſs through; then very great Quantities of Corn heaped high, may by this means be well ventilated: And the Floors may be effectually ſupported from being broke down, by the Support of upright Poſts; but boarded Ground-floors will be beſt, where great Depths and

Quantities of Corn may thus be preſerved good, with little Expence in the Building of Granaries, *viz.* by building them with the Side-walls only about twelve Feet high. 4, 4, Fig. 23. 6. 6. the Rafters of the Roof, with a boarded Ground-floor to lay the Corn on. 8.8.8. With upright lattiſe Fences *b. a. d. e,* five Feet high. The Fence *d. e.* to be three Feet diſtant from the Wall *z,* for Room for Men to walk to and fro: But the Fence *b. a.* to be only four Inches diſtant from the oppoſite Wall *x.* Theſe Fences to be lined within ſide with Hair-cloth, for the ventilating Air to paſs through ſide-ways as well as upward, from the Air-trunk *o*; which lays at the Bottom of the Corn *a. e. c,* the whole Length of the Granary: This Trunk to be eight Inches wide in the Clear within, with both Ends cloſed. The four Seams of the Trunk 1.1.1.1. to be open one-tenth Inch diameter, and to be fixed ſo by means of thin Slips of Wood, or of Sole-leather, about a Foot diſtant from each other.

523. The lattiſe Fences to be retained from ſwerving outward, by the Force of the Corn, by a ſlender Croſs brace *b. d,* with a Dove-tail-faſtening at each End: And the

whole to be fixed from ſwerving ſide-ways, by the reclining Braces 3 3.

524. Now, ſuppoſing the Diſtance of the latice Fences from each other to be 16 Feet, then there will be eight Feet Breadth of Corn on each Side of the Air-trunk *o:* And when the Space between the Fences is not only filled with Corn, but alſo heaped up to *c*, then the Depth of the Corn from *c* to the Bottom will be eight Feet. And it will be well to bring the Diſtances of the Sides and Top of the Corn to be thus nearly equal, from the Air-trunk *o*; that the ventilating Air, meeting with equal Reſiſtance from equal Quantities of Corn, may thereby be the more equably diffuſed through all Parts of the Corn; the Interſtices among Wheat, for the Air to paſs through, being one-ſeventh of the Space that the Corn fills up.

525. WHEN the Corn is firſt put in, let it be heaped up as high as may be upon the Air-trunk *o*; and the ſame to be obſerved in taking away the Corn from the Sides, leaving the Air-trunk covered to the laſt.

526. WHEN only a Part of the Trunk is cover'd with Corn, it will be well to have a ſliding Shutter, to ſtop the Air from paſſing on to the uncovered Part of the Trunk.

527. AND when the Part of the Trunk is uncovered towards the End at which the Air enters, then the open Seams of that Part ought to be cloſed on the Outſide, with long ſmooth Laths, about half an Inch thick, and an Inch and half broad; to be retained in their Place by ſmall Iron Hooks, or rather with ſmall Pieces of Wood, with Notches or Grooves in them.

528. Two Pair of double Ventilators, with Midriffs ten Feet long, and four and half Feet broad, to be laid on each other, on two Beams, in the Middle of a Granary 100 Feet long, if they are worked by a Wind-mill fixed on the Granary: But if they are worked by Water, which is much the beſt Way, then the Air may be conveyed through a ſubterraneous Trunk a Foot within, from the Ventilators to the Middle of the long Air-trunk *o*, under the Corn.

529. There muſt be wooden Shutters to cover on the Outſide, the Holes in the Side-walls of the Granary hung on Hinges at their upper Part, ſo as to cloſe down of themſelves: By this means they will readily open to give a free Paſſage for the ventilating Air, which aſcends through the Corn, to paſs off; but will inſtantly ſhut when the Ventilation ceaſes, and thereby prevent any Dampneſs from the external Air from entering: For which Reaſon the Ventilation ought to be principally in the middle of dry Days, unleſs the Corn when firſt put in, is cold and damp, ſo as to be in danger of heating and growing muſty.

530. Mons. *du Hamel* mentions, in his Book on this Subject, that the moſt frequent Ventilation is requiſite at firſt; but that after ſome time a little Ventilation will ſuffice.

531. By this means he preſerved a Heap of Wheat, ſweet and free from Weevels and Inſects, for ſeven Years, without turning it: For the Eggs of Inſects are obſerved to be hatched principally when the Corn heats; which heating is effectually prevented by Ventilation.

532. ABOUT 8000 Buſhels of Corn may thus be preſerved, in a Granary 100 Feet long, between latice Fences five Feet high, and 16 Feet diſtant from each other; and this without building a large Granary; and much more Corn may be thus preſerved in a Granary a little wider, and with latice Fences, more than five Feet high.

533. IN order to preſerve Corn from being eaten by Rats and Mice, it may be well to nail, on the upper Rail of the latice Fences, ſloping Boards coving over to prevent their getting up. It is ſaid that Rats and Mice will not gnaw Holes through Hair-cloth; but if they do, then it will be well to put Braſs or Iron Wire-work between the Hair-cloth and the latice Fence.

534. IN Ships Corn may be ventilated, by laying thin Hurdles, or Reeds, to the Sides of the Ships, cover'd with Mats, for the ventilating Air to paſs through. And in the ſame Manner Corn may be ventilated in Bins.

535. AND in the Caſe of very cold, damp, muſty, or waſked ſmutty Wheat, there may

be a proper large Bin, in an Apartment to lay it in, where it may have a great Force of ventilating Air given it.

536. In leſſer Granaries, where the Ventilators muſt be worked by Hand, if theſe Granaries ſtand on Staddles, ſo as to have their loweſt Floor at ſome diſtance from the Ground, the Ventilators may be fixed under the loweſt Floor, between the Staddles, ſo as to be worked by Men ſtanding on the Ground, on the Outſide of the Granary, or within it.

537. In Granaries full of large Bins, the Corn may be ventilated either by applying the ſmall moveable Ventilator, *Fig.* 6. but a Size larger than thoſe, to each Bin; or by one Pair of double Ventilators, *Fig.* 2. ſo placed as to blow Air through an Air-trunk fixed in the Front of the Bins, whence Air may be conveyed to any one, or ſeveral of the Bins at once, through Side-holes communicating with the leſſer Air-channels of each Bin; which Holes are to be opened or ſhut with Sliders, as Occaſion requires.

538. Corn may thus be kept ſweet and dry, with little Expence of Ventilation, and

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that chiefly at the firſt laying the Corn in. I believe it will be beſt to ventilate when it firſt begins to ſweat a little, becauſe the Moiſture being then afloat in the Air among the Corn, and on the Surface of the Grains, it will be carried off with leſs Ventilation: And when this has thus been repeated a few Times, the Corn will effectually be freed from the greateſt Part of the Moiſture, which would indanger the Spoiling of it, or the Breeding of Weevels, which is much promoted by the Heating of Corn. And when it is by this means become compleatly dry, it has been found by Experience, that very little Ventilation will afterwards be required; eſpecially if in this dry State the Windows and all Inlets of Air be kept cloſe ſhut, in order to prevent the Entrance of the Air in a damp State: But in a very dry State of the Air, it may be well to open them ſometimes in the middle of the Day; for a freſh dry Air is better than a dry, long confined Air. Ventilation will be more requiſite to keep Corn and Bread ſweet in a hot damp Climate, than in a cold damp Climate, *viz.* becauſe Heat promotes Putrefaction.

539. It is matter of great Conſequence to keep Corn ſweet and dry, not only for the ſake of the Value of the Corn, but more eſpecially for the ſake of thoſe who are to eat it: For Dr. *Pringle* obſerves, that mouldy, putrefied Grain, is apt to produce malignant Fevers: And that Corn kept in a damp Granary, is apt to produce a Dyſentery in the Poor, who live chiefly upon it.

540. All Kinds of Corn, Seeds, or whole Oatmeal, may thus be kept ſweet by Ventilation: And probably alſo Coarſe-ground-oatmeal; for I have found the Air paſs upwards through about ſix Inches Depth of fine Ground-oatmeal, and that in a ſmall Degree when it was preſſed down. But I know not whether it will go through a great Depth of fine Ground-oatmeal, where it will be preſſed down by its great Quantity. It may probably be a good Method to prepare Oatmeal to be laid up in Quantities in large Store-bins; by firſt ventilating it in a Bin, with a falſe Bottom of proper thin-wove Canvas; laying it there of ſuch a Depth only, as ſhall be found by Experience proper for Air to paſs up freely through it. The Air will not paſs through Wheat-meal, notwithſtanding it takes up

much more Room when ground than unground. Air paſſes freely through ground Malt.

541. IN order the better to judge when the Air is in a damp or a dry State, it may be well to have a Cord with a long Rod fixed like a Lever in a proper Manner; by the riſing and falling of one End of which the State of the Air may be pretty well known. Great Care muſt be taken not to ventilate dry Corn in a damp State of the Air; but damp Corn muſt be ventilated in a damp Air. By Ventilation Corn may be made fitter for Uſe ſooner after Harveſt, than it would otherwiſe be. Corn may be moſt commodiouſly and effectually ventilated in Ships, by laying two or three Trunks on the falſe Floor of the Ship; which is made in ſome Corn-ſhips to preſerve Corn from the Bilge-water: The further Ends of the Trunks to be cloſed: But all their four Seams to be opened about one-tenth or one-twelfth of an Inch, for the Air to paſs through among the Corn. This will be much the beſt Method to ventilate Corn in Ships, by laying it thus on a Floor of Boards.

542. But when it lays looſe on Faggots covered with Mats, it may be done by placing two or three long Trunks, about ſix or eight Inches wide, among the Corn; about one-third of the whole Depth of the Corn from the Bottom of it: The Trunks to be about the Width of the Well diſtant from each other. The Ventilators to be fixed on the lower Deck, at the Fore-part of the Ship; whence the Air is to be conveyed by two Trunks to the above-mentioned long Trunks. Theſe two ſhorter Trunks muſt have their Seams cloſed, and alſo a ſhort Joint of Leather, that they may the better comply with the Sinking of the long Trunks, occaſioned by the Weight of the Corn.

543. When Corn is carried in Bags, if the hot, frowzy Air is frequently drawn out of the Hold, the Corn will doubtleſs keep much the better for it, eſpecially if the Bags have ſmall Bruſh-wood-ſticks laid between them, ſo as to prevent their touching one another, and thereby leaving Vacancies, though very narrow, for the Air to paſs freely between them, when the Ventilators are drawing it off. By this means the Corn in each Sack would be kept in a manner almoſt as well, as

if each Sack ſtood ſingle in a Room. Experience will doubtleſs give Hints for further Improvements in theſe Things.

544. Now, ſuppoſe there be 1000 Quarters of Wheat in a Ship; ſince every five Quarters, or 40 Buſhels, take up fifty and half cubick Feet, then 1000 Quarters will take up 252.5 Tuns of Stowage; one-ſeventh Part of which, *viz.* 34.6 Tuns, being Vacancy for Air among the Wheat, a Quantity of Air equal to that, will be drove through the Wheat in much leſs than two Minutes Ventilation, by a Pair of Ventilators, whoſe Midriffs are each ſeven Feet long, and three Feet wide. The Vacancy for Air among Oats, is about one-third of the Space that any Quantity of them take up: And among Peas and Beans it is very large; ſo that any kind of Corn may thus moſt eaſily be kept ſweet.

545. Now, in order to prove whether all the Corn in a Ship or Granary is ventilated, take a Caſk with only one Bottom, and ſet it upſide-down, on any Part of the Corn; if a lighted Candle be held to a Tap-hole in its Side, the Motion of the Flame will ſhew the

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Force of the Air which paſſes through the Corn by Ventilation. Though Ventilation of Corn in Ships will always be uſeful, in order to keep it ſweet, and the freer from Weevels, yet it will be moſt ſerviceable in time of War, when they often wait long for Convoys.

546. Qu. May it not be adviſeable to deſtroy all the Rats and Weevels in a Corn-ſhip, by ſtrong Fumigation with burning Brimſtone, laid in Baſins made in the Ballaſt, before the Ship is loaded with Corn: And if while the Ship is loading with Corn, a little Brimſtone is burnt from time to time, as it is filling, this will be a probable Means to prevent the Breeding of Weevels, and will give no ill Taſte to the Corn.

547. I am told by an experienced Perſon, that Ventilators would probably be very ſerviceable in the Cod-fiſh Ships, where they loſe much Fiſh by the Cloſeneſs of the Hold, notwithſtanding they are continually moving the Fiſh to and fro.

548. Sir *John Philips*, of *Picton Caſtle*, in *Pembrokeſhire*, informed me, that in the Year 1759, ſome Ships laden with Cheeſe,

being Wind-bound for ſome Months at *Milford-haven*, the Cheeſe were much damaged by the great Heat of the Hold, except in one Ship, which had Ventilators, which preſerved them well.

549. I SHALL here inſert a ſhort Account of ſeveral curious Experiments and Obſervations, from Monſ. *du Hamel de Monceau*'s Treatiſe on preſerving of Corn, which he ſent me, *viz.*

550. HE obſerves, that Wheat is the moſt difficult of all Grains to preſerve; that which is cold and damp having one-eighth Part of Moiſture in it: That they are obliged to have large Granaries to preſerve ſmall Quantities of Wheat, becauſe it can lay but 18 Inches deep: And the Corn of a wet Harveſt muſt be turned every third or fourth Day; and yet be ſubject to be deſtroyed by Weevels and other Inſects. Whereas in the way of Ventilation, it may be laid in Heaps of a great Depth; and the more ſo the drier it is.

551. I BELIEVE that ſubterraneous Granaries, lined with Lead to preſerve from damp, might be made at a cheap Rate, conſidering

the vaſt Quantity of Corn they would contain, and their very little want of repairing many Years: They might moſt eaſily be ventilated when needful, by ſmall Air-trunks laid at a due Diſtance at the Bottom of theſe Granaries; where the Corn would be ſecure from Mice and all Kinds of Inſects.

552. Mons. *Duhamel* put 94 cubick Feet, or 75 Buſhels of well-cleaned Wheat, into a Box of Oak, which was the Cube of five Feet, with a falſe Bottom to it, when it was ventilated with Ventilators worked by the Hand, for the firſt three Months eight Hours every fifteenth Day; the reſt of that Year, and the following Year 1744, it was ventilated but once a Month. In the Year 1745 and 1746, it was ventilated but half a Day every Month; and afterwards only every two or three Months. In the Year 1750 he took the Corn out of the Granary, when it both looked and ſmelt well, but was rough to the Hand, becauſe, not having been moved in ſeven Years, the Beards at the End were rough; but having cleanſed and ventilated it, there was no Fault in it: There were no Weevels or other Inſects in this Corn: The Bakers who bought it, and did not know how, nor how long it

was preſerved, gave more for it than for any other Corn in the Market; they obſerved, that it produced very good Flour, ſoaked up more Water in its Paſte, and yielded more Bread than any other Corn in the Market.

553. THE Wheat of the foregoing Experiment being very good conditioned, he took 75 cubick Feet of very cold and damp Corn, of the Year 1745, which in the common Way of keeping, by turning, ſoon heated and had a bad Smell; which he had little Hopes of preſerving by Ventilation, as it was hot when put into the Granary: It was ventilated three or four times a Week the firſt Month, and every eighth Day, during *December* and *January*. As it was now grown freſh, and had loſt ſome of its ill Smell, the next four Months it was ventilated every fifteenth Day. At this time the upper Part of the Corn began to heat; but when that was taken away for a Foot depth, the Remainder was drier than that in common Granaries, and had but little ill Smell; more frequent Ventilation would have prevented this Dampneſs and Heat of the upper Corn.

554. In the Year 1750, Monſ. *du Hamel* fixed a Windmill upon a large Granary, to work Ventilators: And in one Part of the Granary laid 555 cubick Feet of very damp Wheat of the wet Year 1751, being firſt well cleaned from Smut, *&c.* It was laid between four and five Feet deep in the Granary. The Wind ſerved very well the whole Year 1751, and the following Spring; ſo that the Corn was frequently ventilated; which not only dried it, but cured it in part of its ill Smell. This Corn was covered with a dry Duſt, which ſeparated from it as it dried, which it was eaſily cleanſed from, and then ſold at the Price of the beſt Corn.

555. When Corn was thus prepared by drying, he then laid it eight or ten Feet deep in the Store-granary, where it was to remain for a long Continuance of ſeveral Years; and if laid at much greater Depths, the ventilating Air would paſs up freely through it, and a little Ventilation now and then would probably be ſufficient.

556. Lest in *June*, or thereabout, there ſhould be four or ſix Weeks calm, he propoſes to have the Corn firſt cleanſed, and part

dried in common Granaries: But if the Ventilators were made to be worked by a Horſe in long Calms, then this Precaution need not be uſed. His other Precaution is, to dry it in ſome degree in a Stove or Kiln.

557. NINETY cubick Feet of well cleaned damp Wheat, being dried in his Stove, loſt an ill Smell by drying, and kept well without any Ventilation: Though another Parcel of the ſame Corn did not loſe its Smell by the Stove.

558. EIGHT hundred and twenty-five cubick Feet of Corn being in part dried in the Stove, where its ill Smell was ſomething abated, Ventilation afterwards cured the ill Smell; this Corn ſold better than any in the Market. This partial drying on the Kiln is ſhort, and with a gentle Warmth: But it is found that Corn thoroughly dried on a Kiln, does not make good Bread.

559. WHERE Corn can be conſtantly ventilated in the Day-time, it can neither heat, nor contract an ill Smell; for this Purpoſe Water-mills are beſt.

560. Mons. *Giraud*, a Merchant at *Marſeilles*, informs me, that Corn will be damaged by being too much expoſed to the very dry Air of that Country.

561. Mons. *Du Hamel* thinks it probable, that the Eggs of Weevels do not hatch without a conſiderable Degree of Warmth; which is agreeable to the Obſervation of many great Dealers in Corn; who have informed me, that they will not hatch unleſs the Corn ſweats: If ſo, then Ventilation will effectually prevent the Heating of Corn, and conſequently the Hatching of their Eggs; which he has by Experience found that it will effectually do.

562. He ſays that Weevels ſeem dead in cold Weather, and can bear 50 Degrees of Heat on a Kiln, without being killed. And accordingly I found that, on burning many Pounds of Brimſtone in a Malt-houſe-room, which was not ſo big as a Cube of 16 Feet, and abounded with Weevels, many of them were not killed by it: The Fumes of burning Brimſtone among Store-corn, in a well-cloſed Granary, would probably prevent the Prolifickneſs of Eggs.

563. IN building the Walls of a Granary, I think it may be adviſeable to lay a Plate of Lead on the Wall, when a little above the Ground; or two or three Courſe of plain Tiles, to prevent the Aſcent of Moiſture from the Earth.

564. MONS. *Du Hamel* obſerves, that the comparative Expence of his Granary to the great Granary at *Lyons*, is as 3 to 5: And that the *Lyons* Granary contains 86,400 cubic Feet of Corn: But his contains 144,000.

565. HYGROMETERS will be very uſeful, both in Granaries and ſome adjoining Building; in order both to know the State of the Air in the Granary, as alſo that of the external Air, thereby to regulate the propereſt Time for Ventilation.

566. I SHALL here mention the Size of the Midriffs of ſeveral ſingle and double Ventilators, which Mr. *Yeoman* of *Northampton* made for ſeveral Perſons, that thereby the better Judgment may be made of the proper Sizes for different Purpoſes, *viz.*

567. 1745. A SINGLE Pair for Sir *Simeon Steward*, Bart. for a Granary; the Midriff ſix Feet long, and two Feet wide.

568. A DOUBLE Pair for Mr. *Walter Robertſon*, of *Lynn*, for a Granary; Midriffs five Feet by two.

569. 1746. THE like for Sir *John Philips*, Bart. of *Picton Caſtle*, *Pembrokeſhire*.

570. 1748. A SMALL ſingle Pair for a little Granary, for *Joſeph Aſh*, Eſq; of *Dutton*, *Northamptonſhire*; Midriff five Feet by two.

571. 1752. A SINGLE Pair for *Thomas Scawen*, Eſq; of *Maidwell*, *Northamptonſhire*, for a ſmall Granary; Midriff eight Feet by two.

572. IT has been found a good Method, in order to have theſe ſingle Ventilators work the eaſier, not to lift up the Midriffs at the End, as in Fig. 6. but to fix one End of a Lever to the Iron Rod; which Lever reſting on an upright Stand, the Midriff was then raiſed and depreſſed by working the other End of the Lever up and down.

573. The following Method for preſerving Corn ſweet in Sacks I publiſhed in the Newspapers, and in the Gentleman's Magazine for *July*, 1745, believing it would be of great Benefit to the Poor, who frequently keep ſmall Quantities of Corn by them in Sacks; where it is often ſpoiled, and then makes bad and very unwholſome Bread.

574. Provide a Reed-cane, or other hollow Stick, made ſo by glewing together two Sticks grooved hollow; let it be about three Feet nine Inches long; and, that it may be the eaſier thruſt down to the Bottom of the Corn in the Sack, its ſmalleſt End is to be made taper to a Point, by a wooden Plug that is fixed in and ſtops the Orifice. About 150 ſmall Holes, of one-eighth of an Inch in diameter, are to be bored on all Sides of the Stick, from its Bottom to two Feet ten Inches of its Length, but no nearer to the Surface of the Corn, leſt too great a Proportion of the Air ſhould eſcape there. By wreathing a Packthread, in a ſpiral ſcrew-like Form round the Stick, the Boring of the Holes may be the better regulated, ſo as to have them about half an Inch diſtant towards the Bottom, but gradually at wider Diſtances, ſo as to be an

Inch aſunder at the upper Part; by which means the lower Parts of the Corn will have their due Proportion of freſh Air. To the Top of the Stick let there be fixed a leathern Pipe, ten Inches long; which Pipe is to be diſtended by two Yards of ſpiral Wire coiled up within it. At the upper Part of the Pipe is fixed a taper wooden Fawçet, into which the Noſe of common Houſhold Bellows is to be put: Common large Kitchen Bellows convey about three Pints of Air; but ſuppoſing it to be but a Quart of Air, then at the Rate of 64 Strokes in a Minute, they will convey a Quantity of Air equal to the Capacity of a four Buſhel Sack, in two Minutes. And ſince one-ſeventh Part of the Space that Wheat takes up, is the Quantity of Meanders among the Corn, which are full of Air, a Quantity of freſh Air equal to it will be blown in among the Corn with leſs than twenty Strokes. So that if Corn, when firſt put into Sacks, be thus aired every other or third Day, for 10 or 15 Minutes, its damp Sweat which would hurt it, will in a few Weeks be carried off to ſuch a degree, that afterwards it will keep ſweet with very little airing, as has been found by Experience. But if Corn be got ſtale by ſtanding long in Sacks without airing, it would be too much Work to attempt to ſweeten it by this Method; it is therefore beſt thus early to prevent the Staleneſs.

5 5. WHEN many Sacks of Corn are thus to be preſerved ſweet, it may be well to have much larger Bellows, with wider Noſes; for the wider the Noſes, they may be worked both the eaſier and the faſter. And if the Sacks are placed ſo that Cats can go between them, it will prevent the Mice from eating them.

576. BY the ſame Means, many other Kinds of Seeds as well as Corn, may be kept ſweet, either in Sacks or ſmall Bins; but then, in Bins the Air-holes muſt be made only near the Bottom of the Canes, becauſe the Air muſt in that caſe all aſcend upwards, ſince it cannot go through the Sides of the Bin, as it will through Sacks. I ſhall here inſert the Deſcription of a very great Improvement which is made to a *Back-heaver*; which has been long uſed in *Hampſhire*, *Wiltſhire*, and *Suſſex*; which will not only winnow Corn much ſooner and better than by any other Methods hitherto uſed, but will alſo clean and clear it of the very ſmall Corn, Seeds,

Blacks, Smut-balls, *&c.* to ſuch Perfection, as to make it fit for Seed-Corn.

577. THIS I publiſhed in the *Gentleman's Magazine* for *July* 1747. This Back-heaver is four Feet long from *A* to *B*, *Plate* V. *Fig.* 17. and three Feet broad from *A* to *I*, and *B* to *D*. *A*, *B*, *C*, is the Head-board, three Fourths of an Inch thick, and eight Inches and half deep within; *B.C.D*, and *A.F.I*, the Side-boards, eight Inches deep at *B*,*C*, and four Inches and half at *I*,*F*, within; the Bottom *Z*,*Z*, is boarded as far as *X*,*X*, and from *X X*, to *I D*, the Breadth of thirteen Inches and half is Iron Wire-work. Theſe parallel Wires are in Size about one Tenth of an Inch in Diameter, and have their Centers about four Tenths of an Inch diſtant from each other, their Ends being faſtened to the under Parts of the Boards at *X*, *X*, where their Ends are covered with a Liſt of Tin, half an Inch broad, to the upper Part of the Rail at *I*,*D*, that Ears of Corn, coarſe Hulls, *&c.* may freely ſlide off. The Diſtances of the long Croſs-Wires *R*, *R*, are three Inches from each other; they ſerve to ſupport and ſtrengthen the ſhort parallel Wires, being

placed under, and bound faſt to them, with very fine Braſs-Wire.

578. THIS Inſtrument is ſuſpended, with its Bottom about five Feet high, by ſtrong leathern Straps fixed to the Side-boards, at *N*,*X*,*X*, near the Center of Poiſe or Gravity; which Straps *M*, *M*, *N*, *X*, *X*, are buckled together at the deſired Height, over the upper Rail *M*, *M*, which Rail is ſupported by the upright Poſts of the Frame *P*, *Q*, which Poſts ſtand ſeven Inches diſtant from the Ends of the Back-heaver; thereby to leave room for it to be ſhaken to and fro. It is needful, in order to prevent the Frame from ſliding to and fro on the Floor, to have ſtrong-pointed Iron Pins, full half an Inch long, fixed in the bottom Pieces of the Frame at *S*, *S*, *S*, *S*.

579. IN order to keep the Back-heaver ſteady, and in its proper Degree of Inclination, a String or Strap is tied at one End to the middle of the upper Rail *M*, *M*, and at the other End to the middle of the fore Rail of the Back-heaver. If this String be tied to the lower Part of the Frame, which ſupports the Back-heaver, it will not do ſo well. The Back-heaver is ſhaken to and fro in this in-

clining Poſture, by a Perſon who ſtands on a Stool, which is hooked at *Y* to the upright Poſt of the Frame. As the firſt coarſe Hulls and Corn, which are thrown on the Board *Z Z*, *X X*, ſlide down thence on the Wire, the Corn, and ſome of the fine Hulls drop through the Wire; the coarſer Ears and Straws, *&c.* fall off at the lower End *F*, *D*, beyond the Corn; where the Wind from the Circulating Fan or Fagg, which is placed behind near *A*, *B*, blows it away, as alſo ſome of the Refuſe from among the falling Corn.

580. BUT finding that a conſiderable Quantity of the ſmaller Hulls paſſed through this wide Wire Grate, I placed under that Iron Grate *X X*, *I D*, another fine Sieve, which had five ſquare Maſhes in the Space of an Inch, or twenty-five in an Inch ſquare, the Wire being about one thirty-ſixth Part of an Inch in diameter. This Sieve was nineteen Inches and half broad in the Clear; it was fixed in a Frame, *F H*, *H L*, under *L* its hinder Rail, and upon its fore Rail *H*, *H*. Theſe Rails were three Inches broad, and near an Inch thick. This Sieve was ſtrengthened and ſupported by two ſtrong Iron Wires, placed lengthways; and by ſeven of the like Wires,

placed at equal Diſtances acroſs them. This Sieve, with its Frame, was hooked to the Back-heaver by two flat Iron Hooks at each End, which were nailed to the Side-boards of this Frame *H F*, *H L*. And theſe Hooks are prevented from ſlipping down, by two ſmall Hooks drove into the Edges of the Side-boards of the Back-heaver. This under Sieve is not fixed in a parallel Poſition to the upper Sieve or Grate, but inclining ſo, as to have its hinder Rail five Inches below the Back-heaver, and its fore Part only two Inches below the fore Rail of the Back-heaver. By this means, the under Sieve is not inclined ſloping to ſo great a degree as the upper Iron Grate of the Back-heaver, neither ought it to be ſo much inclined, but is to be kept almoſt level, or parallel to the Horizon, leſt too much of the Corn, inſtead of falling thro' the Sieve, by deſcending too precipitately over the Sieve, ſhould run forward with the *Chaff* and *Huzzes* over the foremoſt lower Rail, and ſo not be ſeparated from them. The Frame of this lower under Sieve is not incloſed with a Board behind, that the Wind may freely paſs thro' it. The Side-boards *H F*, *H L*, which are ſeven Inches and three Quarters deep, and two Feet long, are ſtrongly fixed to the back

Rail by two ſquare angled Iron Plates, nailed both to the Rail and Side-boards, whereby to ſtrengthen the whole Frame. This under Sieve, when thus fixed in its Place, reaches to *H H*, about ſix Inches forwarder than the Back-heaver. The great Breadth of this under Sieve, for the Corn to paſs over, gives thereby ſo much the greater Chance for the more Corn to drop through, and to leave the Chaff to be carried on farther beyond the Corn, and conſequently to be blown, as the Chaff falls ſo much the farther from the Heap of Corn.

581. The Advantages of having the Corn paſs thro' both theſe Sieves at once, are very great; for it is found upon Trial that Corn may be cleaned thus much ſooner and better than by the uſual ways of cleanſing Corn. For much the greateſt Part of the Corn which falls thro' this Riddle-Sieve, is at once clear from *Chaff* and *Huzzes*; which *Huzzes*, with ſome Ears, are carried forward on the Surface of the Corn on the Sieve, and fall off with ſome of the Corn over the fore Rail *H H*, which Corn, being tailed off with the Huzzes and Ears, after it is cleared from them by the common Hand Riddle-Sieve, is to be

thrown up in a Heap on one Side, with ſome of the next leſs foul Tailing, in order to paſs thro' the ſame Back-heaver again, and is then to be mixed with the other fore Part of the Corn, in order to undergo another Winnowing with a finer under Sieve, which is next to be deſcribed.

582. **MR.** *Woods* of *Chilgrove* in *Weſt-Dean* Pariſh near *Chicheſter*, being preſent when we were cleaning Wheat with this Inſtrument, the following very ingenious and uſeful Improvement of it occured to his Thoughts, *viz.* When Wheat has paſſed through the above-mentioned Winnowings, then to take away the under Sieve, and place there another like but much finer Sieve in its Room; and to have a Piece of Sackcloth fix'd near under the Sieve to receive the Seeds, very ſmall Corn, Duſt, *&c.* as it falls through the Sieve. This I immediately put in execution. The Maſhes of this Iron Wire-Sieve were ſo ſmall, as to have eight of them in the length of an Inch, the Size or Diameter of the Wire being about one 48th Part of an Inch, *viz.* a ſmall Size leſs than the Wire of the firſt made under Sieve,

583. As this under Sieve ought to be in a ſomething more inclining Poſture than the other under Sieve, ſo it is ſuſpended more nearly parallel to the upper Back-heaver, the hinder Part of it being only one Inch lower from the Back-heaver than the fore Part.

584. A Piece of Sackcloth was nailed both to the hinder Rail of the Frame, and alſo to the foremoſt Edge of the fore Rail, that the Seeds, Duſt, *&c.* which fall through the Sieve might lay under this fore Rail: This Sackcloth was alſo nailed at one End to the Frame, but at the other End it was buttoned over the wooden Molds of eight Buttons, which were nailed for that purpoſe at *r*, that by unbuttoning of this, the Duſt, Seeds, *&c.* might be poured out; the Sackcloth was looſe to ſuch a degree, as to bag down only about four Inches below the Sieve, ſo as very little to hinder the free Paſſage of the Wind from the circulating Fan. This Sackcloth was lined with brown Paper paſted to it with ſtiff Paſte, which had Roſin mix'd with it to prevent Rats and Mice from eating it.

585. Finding upon Trial, that the Corn which is thrown on the Board *Z Z*, *X X*, ſlid down from it too unequally, and ſometimes in too thick a Quantity, this Inconvenience was effectually remedied by placing at *X X* edgeways a long Piece of Board, which was two Inches and half broad; which made the Corn run in a thin even Spread under it; whence, paſſing over the Sieve in the ſame manner, the very ſmall Corn, Blacks, Seeds, Mouſeturds, *&c*, dropped through the Sieve on the Sackcloth; and what could not drop through the Sieve, ſuch as bruiſed Corn, Smut-balls, *&c.* being, in falling in a thin Sheet, expoſed to the Force of the Fan's Wind, was blown beyond the good Corn.

586. The tailing Corn may ſoon be cleaned by paſſing thus ſeveral Times over this fine Sieve, and the beſt of the very ſmall Corn which paſſed through the Sieve, with the Seeds, Blacks, *&c.* may in the ſame manner be ſeparated from them, and then be mixed with other tailing Corn.

587. This Method not only makes much greater Diſpatch, but is alſo better than a Wire Hand-Sieve of the ſame ſized Maſhes,

becauſe by this means the Corn is continually paſſing in a thin Sheet over this Wire-Sieve, which gives Liberty to the Seeds, Blacks, *&c.* to drop through on the Sackcloth; whereas in a Hand-Sieve of the ſame degree of Fineneſs, the Thickneſs of the Maſs of Corn in the Sieve prevents many of the Seeds, *&c.* from falling through the Sieve.

588. So that this happily proves to be an excellent Method to clean Wheat with diſpatch, and effectually, from very ſmall Corn, and alſo from Seeds, excepting that of Crow-Garlick, which grows in ſome few Fields, and ought to be weeded, as is practiſed by ſome Farmers, both in the Field, and in the Sheaf in the Barn, before it is threſhed.

589. THEY who would be very curious in cleaning Corn for Seed, may do well to repeat the ſifting of it through this fine Sieve, ſo as not to leave any Seeds in it.

590. THE like ſmall Seeds may alſo be got out of Barley by this fine under Sieve. When the under Sieve had only three and half Maſhes in the length of an Inch, it cleaned Barley well, and with great Diſpatch.

591. The ſame fine Sieve, with the Sackcloth under it, may alſo be uſeful without a Fan in large Granaries, to clean Corn when it is to be moved or turned, from Seeds, Duſt, *&c.* which Duſt is obſerved to contribute not only to the ſpoiling of Corn in Granaries, but the Meal alſo of foul Corn will not keep ſo well as that of clean Corn.

592. In order to preſerve theſe Inſtruments from being ſpoiled, it will be well to have Shelves in proper Places in the Barn to ſet them on, and alſo to cover the Sieves with Bags of Sackcloth. The Wires *X X, I D,* may be covered with a Sliding-Board. Theſe Wire-Sieves coſt a Shilling a Square-Foot, which is no great Expence.

993. The Wire-Sieve makers ſay, that Iron-Wire is but half the Price of Braſs-Wire, and that it will laſt much longer.

594. When Ventilators are applied to winnow Corn, either in Barns or in Corn-Mills, in order to make the Stream of Air as it ruſhes out the more equal, it will be adviſeable to make the Valve-Box *N. M. Q. Fig.* 3. very large, and its Outlet or Noſe *P,*

ſmall in proportion to the Valve-Holes: By this means, the Inconveniencies from the Inequalities of the Air's Velocity, may in a good meaſure be obviated, ſo as to make the leaſt Velocity ſufficient for the Purpoſe. This is the caſe of the left Ventricle of the Heart and its correſponding Arteries, the Ventricle anſwering to the Ventilators, and the Arteries to the Valve-Box *N.M.* but the Blood being an uncompreſſible Fluid, a very conſiderable Degree of its Velocity is continued in the Intervals of each Contraction of the left Ventricle of the Heart, by the Contraction of the dilated Arteries. And thus the Air, a very dilatable and compreſſible Fluid, being compreſſed in the Valve-Box *N.M*, will by its dilating Power continue to ruſh out at the Noſe *P*, with a conſiderable degree of Velocity in the Intervals of the Impulſes of the Midriffs: which I find to hold true in the Caſe of my large Ventilators, *Fig.* 2, 3.

595. Mr. *Yeoman*, the Author of many ingenious Contrivances, has one for this Purpoſe, *viz.* by fixing a Midriff in the Valve-Box *N.M. Fig.* 3. with its Hinge End juſt over the Valves 2 and 5, and its moveable End over the Noſe *P*. And there being no Cover

or upper Board *Q. N. l.* to the Valve-Box; this Midriff, whoſe Edges are lined with Sheeps Leather, ſupplying its Place, and riſing a little when the Air ruſhes with greateſt Velocity out of the Ventilators, and falling when the Motion of the Midriffs of the Ventilators is changing; whereby the Stream of Air blows with a more uniform Velocity on the falling Corn. In his firſt Trial he made the Valve-Box and its regulating Midriff one-fourth of the Length of the Ventilators, and afterwards two-thirds of that Length; and propoſes in the next which he makes, to have the regulating Midriff of an equal Length with the Midriffs of the Ventilators. By this means, the greateſt Velocity is ſomewhat abated. But when this cannot commodiouſly be done, and will make the Work too large, it may ſuffice to have the Valve-Box *N. M.* pretty large, and its Noſe *P* of ſuch a diminiſhed Size, in proportion to the Valve-Holes, that there ſhall be a conſtant Stream of Air ruſhing out at *P*, whoſe leaſt Velocity ſhall be ſufficient to winnow Corn well.

596. In ſome Parts of *England*, they employ People to pick the ſmutty Ears out of the Corn before they threſh it. In other

Places, inſtead of threſhing, they beat the Corn which has ſmutty Ears among it, on the Bouge of Caſks turned down ſideways, thereby the better to avoid the breaking of the Smut-balls. Some threſh it with good Effect on Barley Hulls. A great Dealer in Corn informs me, that a conſiderable Part of the Smut of ſmutty Corn may be cleanſed away when the Corn is very dry; and Corn may be made very dry by Ventilators worked by a Water-mill; or ſmutty Corn may be there waſhed in the Stream, and thoroughly dried by Ventilators worked by the Mill. And from the Account that is given by Monſieur *de Salerne*, in the ſecond Volume of the Memoirs of the Royal Academy of Sciences, publiſhed in 1755, of the very noxious Quality of ſmutty Wheat, more eſpecially of the new Wheat, we ſee great Reaſon to uſe all proper Means to cleanſe it of the Smut, which Wheat is obſerved to be moſt ſubject to in wet Years. The Illneſs is obſerved to begin ſoon after Harveſt, and is ſo very malignant, that of 120 Patients ill of it in the *Hotel Dieu* at *Paris*, but four or five recovered; their Legs mortified, neither would Amputation prevent, but haſten their Death; and thoſe who recovered, were obſerved not to live long. A Hog and Ducks have been killed by eating it.

597. Mr. *Yeoman* has ingeniouſly contrived and made what he calls a *cleanſing Engine*, which conſiſts of three Parts, the Corn paſſing through three different Operations at the ſame Time: The firſt is to break the Smut-balls, and clear the Smut which is apt to adhere to the ſoft Ends of the Wheat, by the ſtrong Friction of a ſtiff round Bruſh, which is two Feet in diameter; whoſe Motion is like that of the upper Stone of a Corn-mill, and receives the Corn in the ſame manner through its Middle. Upon the Bruſh is a Stone to give Weight and Steadineſs to its Rotation; it ſerves alſo as a Flier. Under the Bruſh he at firſt put a Tin Plate punched full of rough Holes like a Nutmeg or Bread-grater, but finding that it wore out ſoon, he makes uſe of the *Darby Peak* Mill-ſtone. While the Corn is paſſing between the Bruſh and the Stone, the Smut-balls are broke, and the black ſtinking Smut which adheres to the ſoft Ends of the Corn, is thereby in a good meaſure rubbed off. Hence the bruſhed Corn falls on a flat broad Wire-Skreen, which lies gently inclining. This Skreen is jogged or

ſhaken lengthways by a ſhort Crank or Crook in the lower Spindle, which turns the Bruſh round, whereby the Corn is ſpread thin all over the Skreen, and whereby it is cleared of the thin Corn, the Duſt and Seeds. The Corn is expoſed to a Blaſt of Wind from a ſmall Ventilator as it falls in a thin Sheet from the Skreen. The ſmall Ventilator is worked by a Crank or Crook in the Axletree of the Cog-wheel, which upright Cog-wheel moves another horizontal Cog-wheel, whoſe Axletree as it turns, gives Motion to the Bruſh and Skreen. The laſt cleanſing Engine which he made of this Kind, had another Ventilator to blow the Wheat as it falls in a Sheet from a Granary into the Hopper which is fixed over the Bruſh; by which means the Wheat is cleared of a great many of the Smut-balls, Duſt, and other light Matter.

598. The firſt cleanſing Engine which he made is turned by Hand with a Winch, with which a Man can eaſily dreſs two Quarters of Wheat in an Hour: The ſecond is turned by a Water-Wheel, and will dreſs four or five Quarters in an Hour: Another of theſe Hand-mills will dreſs twenty Buſhels of Wheat in an Hour, after it is winnowed. It is found that

no Method yet made uſe of by Farmers or Millers, comes up to this for dreſſing of Wheat; but yet it does not do all that he would have it do; for when Corn is very much black'd at the ſoft Ends, it will not all bruſh off, though it brightens it very much, and breaks moſt of the Smut-balls. He was at firſt apprehenſive that the Bruſh would ſoon wear out, but an hundred Quarters a Week were dreſſed with it for two Years before it was worn out.

599. WHEN Weevels are once got into Corn, it is not eaſy to deſtroy them. I have formerly, in a ſhort Treatiſe on that Subject, propoſed ſome Methods to deſtroy Weevels in Corn, by cauſing the Fumes of burning Brimſtone to aſcend up through it of itſelf; which Method General *Oglethorpe* told me he had tried with Succeſs in *Georgia*; and may probably do in ſmall Quantities of Corn. But having, ſince my Publication of that Method, made ſome Trials to convey the Fumes of burning Brimſtone up thro' Corn in much greater Quantities by means of Ventilators, which I find does much better than when they aſcend only of themſelves; yet I find that even by Ventilation, in the caſe of great

Quantities of Corn, it will require long and much Fumigation. For though the Fumes of the burning Brimſtone aſcend plentifully up through Corn which lay on a falſe Bottom of Haircloth when conveyed by Ventilators, yet the Coldneſs of the Corn, and the damp Vapours which the warm aſcending Fumes raiſe, very much abate their Acrimony, ſo as to make them leſs ſuffocating, and leſs deſtructive of Animal Life; which I found by Experience, by fuming thus a large Quantity of Oats which lay a Yard deep in a Bin of forty ſquare Feet, at the Right Hon. the Lord *Feverſham*'s, at *Barford* in *Wiltſhire*. For tho' the Fumes, as they aſcended up through the Corn, were ſo ſuffocating that a Man could not bear to breathe in them, yet neither a Sparrow, a Mouſe, Ants nor Earwigs tied up in Canvas, were killed, not in about an Hour's Fumigation. But in this Experiment, the Length of the Space which the Fumes paſſed through the Ventilators and Trunks, was about twenty Feet, and the Trunks were too ſmall. This Fumigation was made with Ventilators a Size larger than thoſe deſcribed in *Fig.* 6, the Fume being drawn into the Ventilators from a ſquare wooden Tunnel or Hopper, which was placed inverted over the burning Brimſtone. The Brimſtone will burn the more freely if Charcoal be burnt with it, or a red-hot Iron be put into it. But though theſe Creatures were not killed in an Hour's Fumigation, yet ſince Bugs are dried to Powder in two Hours Fumigation of large Rooms, perhaps large Fumigations may have the like Effect on Weevels in Corn, eſpecially if the Corn be dry, and covered with Cloths.

600. I FOUND this way of Fumigation very effectual when I fumed a leſs Quantity of weevelly Malt, which lay ten Inches deep in a Box which was ſeven Inches wide each way. The Fumes of the burning Brimſtone were blown upwards through it by a Pair of common Kitchen Bellows, whoſe ſucking Valve was placed over a large Hole cut in the Bottom of an inverted Oil-Jar, at the Diſtance of thirty Inches above the burning Brimſtone. A Sparrow and Bee which were placed on the Malt, and covered with coarſe Cloth, were dead in three Minutes, and ſeveral other Inſects in fifteen Minutes. On examining the Malt, the Weevels were all dead; even thoſe which lay hidden in the midſt of the Grains. No Weevels were ſeen aſcending to the upper Part of the Malt during the Fumigation, which

I am told they will do when the lower Part of the Corn in Ships grows too hot for them to continue in it. The Temperature of the open Air was twenty Degrees above the freezing Point: and the Heat of the Fumes among the Malt, at the End of fifteen Minutes, was forty-eight Degrees, which is three-fourths of the Heat of Blood.

601. VARRO *de Re Ruſtica* ſays, that Pellitory of the Wall mixed with weevelly Corn, drives them away; and I am informed, that both in *England* and *Ireland* it has been tried with Succeſs.—— Dwarf Elder and Garlick are ſaid to drive Inſects from Corn, by rubbing the Walls, *&c.* with it. *Spectacle of Nature*, Vol. 2. p. 212.

602. I SOWED in my Garden in *November*, at ſix Inches diſtance, ninety-ſix Grains of the ſmalleſt and pooreſt Wheat that I could pick out; and at the ſame Time ſowed the like Number of fair Grains of Wheat, which I bruiſed with a Hammer: only three Grains of the bruiſed Corn grew, whence came eighty-ſeven Ears, ſeveral of them very large; but the Grains of the beſt Ears were very ſmall and ſhriveled,

603. As to the ninety-ſix ſmall Grains of Wheat, only fifteen of them grew, they bore 308 Ears, one had twenty-ſeven Ears; many of theſe Ears were ſix Inches long. The Grains of the beſt and faireſt Ears were ſmall and withered, but the Grains of many of the Ears were exceeding ſmall and ſhriveled, ſo as ſcarce to have any Form of Grains; and in many of the Ears there were no Grains.

604. The Year following I ſowed 200 Grains of good Wheat on the ſame Spot of Ground; the Ears were large, and the Corn fair and of a good Size.

605. Hence we may reaſonably infer that the fairer and better the Corn is that is ſown, the greater Probability there is of a good Crop of fair Corn: and at the ſame Time we ſee how unadviſeable it is to ſow poor ſmall Corn, which is practiſed by ſome Farmers, for two Reaſons, *viz.* becauſe ſuch Corn will not ſell for ſo good a Price as fairer Corn, and becauſe there are the more Grains in a Buſhel of ſuch ſmall Corn, and conſequently it will ſow the more Ground. On the other hand, it is probable that the faireſt Corn when ſown, will be leſs ſubject to Blight and Smut, and

better able to endure inclement Seaſons; by throwing Seed-Corn into Water, the bad, which floats on the Surface of the Water, may eaſily be ſkimmed off and ſeparated from the Wood.

606. IN order the more fully and clearly to know which is the beſt Practice, both Kinds of Corn ſhould at the ſame Time be ſown ſeparately in the ſame Field.

607. MONS. *du Hamel de Monceau*, who tranſlated and abridged *Jethro Tull*'s *Book of Huſbandry*, by cultivating Wheat in that Method in the vacant Places of Vineyards, had in three Years one-third greater Increaſe than in the common Methods of Huſbandry. The Rev. Mr. *Hollier* of *Carſhalton*, *Surrey*, in the Year 1720, had from one Barley-corn planted in his Garden, 154 Ears, which contained 3300 and odd Grains of Corn, which being planted in a Field three Inches aſunder, produced half a Buſhel and half a Peck of Corn, which being planted in the ſame manner the third Year, produced forty-five Buſhels and a Peck. And Monſ. *du Hamel* mentions the like Increaſe from a Grain of Corn in *France*.

608. IN order to try how ſoon and how effectually raw Gunpowder might be dried, by blowing hot Air upwards through it, I provided a Box which was a Foot ſquare, with a falſe Bottom of ſuch cloſe wove Canvas, as the Powder-makers uſe to ſift the Duſt from their Powder; which Canvas was ſupported with a Lacing of Packthread, which was alſo ſupported with three Sticks, at equal Diſtances, which Sticks reſted on little Pillars. *July* 30, a dry Air, eight Pounds of raw undried Gunpowder were put into this Box; under the falſe Bottom of which was fixed at the Hole in the Side of the Box, the upper Part of a Worm-pipe of a diſtilling Worm-Tub, which was filled with twenty-two Gallons of boiling hot Water. To the lower End of the Worm-pipe was fixed the Noſe of a common Pair of Kitchen Bellows, whoſe lower Handle was ſtrapped down with a Piece of Leather to the Board on which the Blower ſat, by which means the Bellows were worked with great Eaſe. The Heat of the Air which came through the Worm-pipe, was 150 Degrees, 212 of which is the Heat of boiling Water; ſo that it was very near three-fourths of the Heat of boiling Water. And having placed a mercurial Thermometer

in the Powder, I could obſerve how the Heat increaſed ſtill more and more as it dried; ſo that at the End of two Hours the Heat was increaſed to 120 Degrees; when it was dried to ſuch a degree, as to be full Proof as to Strength; as appeared by Trial with the Proof Inſtrument.

609. I DRIED thus a great Variety of Flowers, with hot Air drove through the ſpiral Pipe of a Worm-Tub, up through a Box of Sand in which the Flowers were placed, ſo as to be dried with their natural Form; many of which retained their Colours well for ſome Weeks and Months: But at laſt they faded, and loſt their Colour, ſome ſooner, ſome later; which ſome of them might probably have retained longer, if Means had been uſed to keep them from Air by Gum Arabick, *&c.*

610. IN the ſame manner fifty Pounds of raw Gunpowder were dried at Mr. *Norman*'s Powder-Mills at *Eaſt-Moulſey*, *Aug.* 21, the Air being then dry, cool and cloudy, the Wind S. W. the Powder was put into a Box a Yard ſquare, with a like falſe Bottom of Canvas on which it lay about two Inches

deep. The Box being placed near one End of the Powder-drying Stove, hot Air was conveyed thence through large Trunks, by the working of the ſmall Ventilator, *Fig.* 6. The Heat of the Air juſt before it came to the Powder, was 142 Degrees. After two Hours and ten Minutes Ventilation, the Heat of the Powder was 137 Degrees, when it was completely dried; ſo as to be by the Proof Inſtrument of the ſame Standard of Strength with ſome of the ſame Powder dried in the Stove in the uſual way: and it was obſervable that the Waſte in drying was the ſame. Hence we ſee that great Quantities of Powder might thus be dried with much Safety and leſs Expence, eſpecially if the drying Houſe was ſo near a Stream as to have the Ventilators worked by a ſmall Water-Wheel; which would ſave the Expence of Labour in working them: or they might be worked by the Labour of the ſame Horſe that grinds the Brimſtone or Charcoal.

611. FROM the Event of the Experiment in drying eight Pounds of Gunpowder in two Hours, by means of hot Air being drove thro' the Pipe of a diſtilling Worm-Tub, it may reaſonably be concluded that the damp Gunpowder

powder in Ships will be much more expeditiouſly and effectually dried thus, than by the preſent Method of drying it in broad Pans heated with hot Water under them; becauſe in this ventilating Way a Succeſſion of hot aſcending Air inceſſantly ſurrounds and paſſes by each ſingle Grain of Powder, and thereby carries off the Moiſture: whereas in the Method with heated Pans, there can be no ſuch Stream of hot Air to warm at the ſame Time the upper as well as the lower Part of the Powder; which may therefore be layed the thicker in the ventilating Way, and yet be ſooner dried. The Powder-makers ſay, that as the common Degree of Dampneſs of Ship Powder is not near ſo great as that of raw undried Powder, ſo it will dry in much leſs Time: They alſo ſay, that if Ship Powder is as damp as raw Powder, no degree of drying can make it good without being firſt made up.

612. Now in order to apply this Experiment to the drying of damp Powder in Ships, it is propoſed to have a Box with a falſe Bottom of Canvas about a Yard ſquare, on which fifty Pounds of Powder will lay about two Inches deep. And whereas the ſpiral Worm-

pipe abovementioned, was about ten Feet long, and the Diameter of its Bore but half an Inch; it is propoſed to have it an Inch or Inch and half diameter, and the ſpiral Worm-pipe to be conſiderably longer, that the Air may be the more heated, by paſſing through ſo great a Length of ſo large a Pipe. It is propoſed alſo to have the Bellows large, or rather to uſe very ſmall Ventilators, about two Feet wide. A Trial of this Kind may be firſt made on Land, with little Expence.

613. WE have hence alſo a Hint for drying ſeveral Kinds of Things, as Corn, *&c.* without communicating to them any Fume of Fire, *viz.* by conveying plenty of hot dry Air among them, by means of a large Worm-pipe fixed in a large Caldron, where a ſmall Fire would keep the Water in a conſtant ſcalding Heat; its Waſte by Evaporation to be ſupplied by a conſtant ſmall Stream, and the Quantity of its Waſting to be much checked by a cloſe Cover; the hot Air to be impelled through the Worm-pipe by Ventilators of a proper Size.

614. I AM informed, that in the *Eaſt-Indies* they expoſe the Saltpetre to drying

open Air and Winds, in order to make the Powder the ſtronger. And if Saltpetre thus dried, will make the ſtronger Powder, notwithſtanding it muſt be wetted too, in order to make Powder; is it not hence probable, that Powder dried only with a very dry Air, will be ſtronger than Stove-dried Powder; where it is alſo in danger of being damaged by over-heating? And might not a great Quantity of Powder laid of a conſiderable Depth in a falſe Bottom on Canvas, be ſoon dried in a hot Climate, in the middle of dry Days, by blowing Air upwards through it with ſmall Ventilators?

615. Having thus dried damp Gunpowder by blowing the common dry Air upwards through it, it led me to propoſe many Years ſince in my Ventilator-book, the preſerving Powder in the Powder-room of Ships dry, and conſequently good, by blowing freſh Air into the Powder-room for about a quarter or half an Hour in the middle of dry Days, two or three Days in a Week, with the ſmall Ventilators, *Fig*. 6. For if freſh dry Air will dry damp Powder, it is reaſonable to believe it will keep dry Powder dry. The Hon. Count *Bentinck* informed me, that he had

known Powder keep perfectly good for above a hundred Years by being preſerved dry. And having been ſince frequently informed, both by ſeveral Commanders of Men of War, and by the Makers of Powder for the Government, that the Powder in Ships is apt to ſpoil, occaſioned by the damp putrid Air of Ships, which ſoaks not only into Cartridges, but alſo thro' the Subſtance of the Wood of the Barrels; which Inconvenience may be prevented by blowing freſh dry Air into the Powder-room as long and as often as Experience ſhall prove it to be neceſſary: which may be known either by weighing a Cartridge, or by an Hygrometer properly fixed, ſo as to ſhew with great Accuracy by a Hand turning in a Circle, which Hand may turn on a ſmall Wire paſſing through one Side of the Powder-room. But the ſmall Ventilator muſt be ſupplied with freſh Air either by a Trunk leading to a Port-hole, or by ſome other Means that ſhall be thought beſt. And in order to change the whole Air of the Powder-room, it will be requiſite to have it blown in at one End, and out at the other End; and where it is blown out, there muſt be a Valve to cover the Hole, ſo as to open for the Air to paſs out, but to fall to immediately of itſelf,

ſelf, thereby to prevent the Entrance of the damp putrid Air of the Ship: And when the Ventilation is over, the two Holes, which need be but four Inches wide, may be ſtopped as effectually, and with as great Security as if there had been no Holes.

616. POWDER in large Magazines, may be ſomething the better preſerved by having ſeveral Hygrometers in them: and one Hygrometer expoſed to the outer Air, yet ſo as not to have Rain fall on it. This is to be for a Standard, thereby not only to know when are the proper Days and Times of Day to admit the external Air into the Magazine, but alſo to know the comparative Drineſs of the Magazine at all Times, with the drieſt external Air.— The Shutters and Doors ought to be made as Air-tight as poſſible. Whenever the Floors are wetted, in order for the Mens working with Safety, I believe it will be better to admit a free thorough Paſſage of the external Air, with a greater Degree of Dampneſs than one would otherwiſe chuſe, when the Floors are dry: But in what degree of Dampneſs the external Air may be admitted, will be beſt determined by the Hygrometers. But ſuppoſing the Air of the Ma-

gazine to be very damp with a wet Floor, then it is certainly better to have an equally damp freſh external Air paſs through the Magazines than not; becauſe a confined damp Air is conſtantly tending to a State of Putrefaction, that moſt ſubtile Diſſolvent in Nature; and will therefore in that State be more apt to penetrate through the Wood of Barrels. This, as I gueſs, is often the Caſe of Powder-rooms in Ships. But when Magazines are under Ground, or ſo conſtructed and conditioned that the external Air cannot at proper Times be admitted to paſs freely through; in theſe Caſes the blowing Air in with Ventilators, through long Trunks reaching to the farther End, oppoſite to where the Air goes out, would probably be of ſervice.—— As to the Benefit which is found by turning the Barrels, I gueſs the Reaſon of it is to prevent its caking, by thereby changing the Points of Contact of each Grain; and if ſo, then the moiſter it is, the oftener it ſhould be turned.

617. Would it not be well to lay a thick Coat of Paint on each Barrel when the Wood is well ſeaſoned? For as Paint is well known to keep the ſappy Damp of Wood from evaporating, ſo doubtleſs it will conſiderably con-

tribute to hinder the ſoaking in of the Damp from a damp Air. The ingenious Dr. *Lewis* of *Kingſton*, found that Moiſture would not ſoak into a Fir Board, which was painted with Litharge and Oil boiled. A great Variety of Paints, *&c.* might eaſily be tried, which would doubtleſs lead to the better preſerving Powder in Barrels. The Wood ſhould be firſt well ſoaked with Oil before it is painted, elſe the Wood, by ſucking away the Oil of the Paint, will leave it a mere uſeleſs dry Powder.

618. VENTILATORS might probably be of ſervice in making Salt, as was long ſince hinted to me by the excellent Dr. *Wilſon*, late Biſhop of *Sodor and Man*; but then, in order to this, it will be neceſſary to have the Convenience of the Stream of Water to work the Ventilators; and the Brine muſt be in long narrow Canals, covered with Boards or Canvas, about a Foot or leſs above the Surface of the Brine, in order thereby to confine the Stream of Air ſo as to make it act upon the Surface of the Brine, to carry off the the Water in Vapours; for as falling Water carries down Air with it, ſo does moving Air carry with it ſome of the Water with

which it is in Contact. Hence it is that Rain not only moiſtens the Earth, but alſo brings down Air mixed with it, as well as other nutritive Materials, to make it the more fruitful: And for the ſame reaſon it is probable, that River-weeds are obſerved to thrive and grow beſt after Showers of Rain. Hence we ſee how reaſonable the Practice is to water Plants with a Shower through the Roſe of a Watering-pot, in imitation of Nature.

618. AND not only the Expence of Fuel might by this means be ſaved by thus evaporating the Moiſture away to a ſtrong Brine, but it may by the ſame means be reduced alſo to a dry Salt in Winter and Summer, both in a rainy and dry State of the Air, the Salt being thin ſpread. For I found that a Linen-cloth which was hung under a Shed, open on all Sides, which was very wet, with eight Ounces and half of Water in it, had ſeven Ounces and three Quarters dried away in eighteen Hours in Winter; during the greateſt Part of which Time it rained, there being a ſtrong Wind. And large Ventilators worked by a conſtant Current of Water, would blow a conſtant Stream of Air over the Surface of the Salt-water in a long Canal. For ſince

Bay-ſalt can thus be made in Brine-ponds and Pits on the Coaſt of England, without Fire, notwithſtanding we have much moiſt Air, and but a ſmall Proportion of Sun-ſhine; Salt will doubtleſs be dried by a conſtant Stream of Air, which is well known to dry more than Sun-ſhine, becauſe Air and Water mutually attract each other; and if this can be effected, then the Salt thus made will be much the better for it, not only on account of having little of its fine acid Spirit evaporated away, as is done by the great Heat of Fire, eſpecially at the latter Part of the Operation, but alſo, as is obſerved by Dr. *Brownrigg*, in his ingenious Treatiſe on *The Art of making Salt*, p. 250. "That as Sea-ſalt pre-
" pared by the Heat of the Sun is more free
" from *Scratch*, which is white calcarious
" Earth, and alſo from Bittern than moſt
" Kinds of white Salt; it is more proper for
" preſerving Fleſh and other Kinds of Provi-
" ſions. For the Marine Bay-ſalt is not ex-
" tracted in a haſty tumultuary Way, but by
" a ſlow and gentle Heat; ſo that when a
" certain Portion of the Water has exhaled,
" the calcarious Earth ſeparates from it, and
" ſubſides in the Brine-ponds, being depo-
" ſited before the Brine enters the Salt-pits,

" where the ſaline Particles concrete together; " and after they have united into pretty large " Cryſtals, are drawn out pretty free from " the Salts of the Bittern, which remain diſ- " ſolved in their watry Vehicle."

620. BY this means, white Salt may be made with little Expence, and without carrying off much of its Virtue, the Spirit of Salt, by the great Heat of Fire, and alſo from much of the Dirtineſs of Bay-ſalt, eſpecially if they give the Brine a Boil, juſt only ſufficient to clarify it with White of Eggs.

621. As the Ventilators would be worked by a Stream of Water, they might be very large, and have ſeveral of them laid one on the other; and where Water cannot be had, they might be worked by a Wind-mill; by which leſſer Quantities of Brine would be made, as it would ſtand ſtill about one-fourth of a Year for want of Wind: whereby great Quantities of Air might be conveyed with great Velocity, ſo as to be ſufficient to ventilate at once two or three long Canals. For it would be requiſite to draw off the firſt Brine into another Canal as ſoon as the *Scratch* is ſubſided to the Bottom, and alſo into a third

Canal, to dry the Salt when ſeparated from the Bittern.

622. VENTILATORS might alſo be of uſe to thoſe who waſh large Quantities of Linen in great Towns, if the Linen were hung in low, long, narrow Galleries, eſpecially in damp rainy Weather; which would not only dry the Linen whiter than by Fires, but would alſo prevent the Danger of firing Houſes, which has often been occaſioned by the large Fires they have to dry Linen.

623. THEY would alſo probably be of uſe in drying in the ſame manner woollen Cloths after they are fulled or dyed; and the Ventilators might be worked by the fulling Water-mill.

624. SUCH whole Pieces of woollen or linen Cloths might alſo probably be well dried, being hung about ſix Inches diſtant in long, narrow Galleries, which ſuppoſing they were ſituated lengthways Eaſt and Weſt, then when the Wind was North, to have a Door at one End with Hinges, on the South-ſide: this Door to be opened at an Angle of forty-five Degrees, more or leſs, according to the dif-

ferent Points the Wind is at: and at the other End of the Gallery, the Door to be fixed with its Hinges, on the North-ſide: this Door alſo to ſtand open at a proper Angle. By this means the Air which is drove in at the other End, will be drawn out at this End; as I have found by Experience, by laying on a Wall a Trunk thus prepared, which was ſix Feet long and two Inches wide within, when the Flame of a Candle held at the proper End, was forcibly blown on by the Air which came through the Trunk. And when the Wind is in the South, the contrary Doors of the Gallery muſt be opened in the ſame manner; and when the Wind is eaſterly or weſterly, then both Doors at each End muſt be opened to proper Degrees, ſo as to form Tunnels to conduct the Wind in at one End, and promote its paſſing the more freely out at the other End. By this means the Wind in all Points will paſs through the Gallery, and will conſequently dry the Cloths. The ſame Method would alſo be uſeful to thoſe who waſh great Quantities of Linen.

625. As to Malt or Hop-kilns, I believe it would be beſt to have the Air-trunk enter the Kiln about eighteen or twenty-four Inches

from the Ground, and juſt oppoſite to the Fire: But in order to prevent the Air's blowing too ſtrongly on the Fire, I believe it would be well to have a Skreen of Brick-work about a Yard diſtant from the Hole of the Air-trunk, a Yard high and a Yard long; the Bricks may be laid without Mortar, eſpecially at a firſt Trial, with their Ends about two Inches diſtant from each other. By this means the Air from the Ventilators would be the better diffuſed through the whole Kiln: Experience will beſt rectify theſe things. As the Indraft of Air at the Fire-place, will be leſſened while the Ventilators work, ſo it is probable there will be need of more Fuel to keep a ſomething larger Fire, which may be done when Ventilation is uſed, without danger of making the Malt too brown; becauſe when the Quantity of warm Air which aſcends thro' the Malt, is much increaſed, the Moiſture will be carried off ſo much the faſter, and thereby prevent its being ſtewed too much in its own Wreak.

626. I PUBLISHED in the Year 1739, a Propoſal for ſalting Animals whole, by injecting warm Brine into the Arteries by the Force of a perpendicular Height of that Liquor thro'

a hollow Cane about eight or nine Feet high, for Oxen, and half that Height for Sheep, Hogs, *&c.* which Force is nearly equal to the Force with which the Heart impels the Blood through the Arteries. This I thought a probable Means to make Fleſh immediately take ſalt when it had ſalt Brine in it, to melt it; whereas in hot Climates Fleſh putrefies ſoon, before the Salt has time to enter far into it.

627. The Efficacy of this Method is now fully proved by Experience: For having furniſhed my Pariſhioner Mr. *Macferſon*, then Purſer to the Hon. Admiral *Boſcawen*, in his Expedition to the *Eaſt-Indies*, with a braſs Cock proper to faſten to the great deſcending Artery on the left Side of the Back-bone, at the Small of the Back, he made the Trial at *Madagaſcar*, on four Oxen, in the Mid-day Heat, by injecting Brine thus for five or ſix Minutes only; for it immediately flows to the extremeſt Parts, and pervades all the Fleſh to ſuch a degree as to make it readily take ſalt, when cut in proper Pieces to be ſalted and barrelled. This they fed upon for two Months in their Voyage home, till it was all eaten; it continued good to the laſt. This Method of preſerving Fleſh in hot Climates,

mates, will therefore doubtleſs be of ſervice, eſpecially to Seafarers.

628. WHEREAS Fleſh ſoon putrefies in hot Climates before its inner Subſtance can get cool and take ſalt; this Inconvenience may probably be in a good meaſure prevented by ſuſpending an Animal (as ſoon as it is flead, and its Inwards taken out, and its Breaſt laid open and ſpread flat) in a Well or other cool Place under Ground; the deeper the better: and then blowing freſh Air frequently, *viz.* every half Hour, from a Ventilator above Ground, through a Trunk of four or five Inches wide within, and reaching down to the lower Part of the Animal; under which muſt be ſuſpended by Cords, an open wooden Veſſel to receive the Blood, *&c.* that may drop from the Animal, which if it dropped to the Bottom of the Well, would make it ſo putrid a Place, as would haſten inſtead of retard the Putrefaction of Fleſh. This Veſſel muſt therefore at proper Times be drawn up and cleanſed. The Ventilator may be of the ſame Make with the ſingle one, *Fig.* 6. but a Size larger.

629. AND if a Coule, *viz.* ſuch as are on Malt-houſes, were fixed to the Top of the

Trunk a Foot wide, which goes down into the Well, with its Fane ſo placed behind it, at to cauſe its open Part always to face the Wind; this would convey down a continual Stream of freſh Air whenever the Wind blew; ſo that the Ventilators need only be uſed in calm Weather. In our Sugar Iſlands the Wind conſtantly blows either to or from Land. By this means the Fleſh will not only be in a cooler State, but the damp foul Vapour from the Animal, which would ſoon putrefy, will be inceſſantly carried off before it can have time to putrefy: And thus Fleſh both raw and dreſſed, might be kept much longer ſweet, and alſo free from being blown with Flies Eggs. The Degrees of Coolneſs of ſuch a Well at different Depths, may eaſily be known by letting down a Thermometer.

630. I AM credibly informed, that in *Lapland*, *Muſcovy*, and other cold Countries, they prevent the ill Effects that Freezing would have on Fiſh, Fleſh, Fruit and Wine, by immerſing them for ſome Time in very cold Water, where they will be ſurrounded by a Cruſt of Ice, occaſioned by their frozen State; which Ice being broken off, the Fiſh, *&c.* will be good to eat.

631. Numb. 234. Vol. I. a Propoſal is made to try whether a Sheathing of Fir-boards ſoaked in vegetable Oil, might not be very ſerviceable and durable; but Animal Oil, ſuch as that of Fiſhes, will not preſerve Wood. Since which I laid four large Pieces of Fir-boards to ſoak in Rape-ſeed Oil for ſix Months, two of which were of white, and the other of red Fir; the Oil ſoaked but about one-tenth of an Inch into the white Fir, but quite through the whole Subſtance of the red Fir, though it was three quarters of an Inch thick. And the ſame is obſerved in painting of Wainſcot, the Oil not ſoaking near ſo much into white Fir, which has had its Turpentine-ſap drawn off, as into red or yellow Fir or Deal, which is full of Turpentine; and therefore it is cheaper to paint the white than the yellow Deal Wainſcot. Oak muſt firſt be well oiled, or elſe the Colour will be ſeparated from the Wood. This Difference might plainly be perceived both by the Smell, as alſo by the ouzing out of Plenty of Oil before the Flame of ſmall Chips of the red Fir; but on burning thus the white Fir, the Oil ouzed out only near its Outſides. Whether any thing diſagreeable to the Taſte of theſe Worms can be made to penetrate

with the Oil into the Subſtance of red Fir, muſt be left to farther Reſearches. As the thus ſoaking Fir in Oil will give the Boards a great degree of Toughneſs and Durableneſs, it may be of conſiderable Service to uſe ſuch oiled Boards, (at leaſt in the Line of the Surface of the Water) round Ships, and on their Bowes, where they are moſt ſubject to decay, or to be torn off: But to ſoak in Oil thus for the whole Sheathing of a Ship, might be too expenſive; beſides that it may be doubtful whether the Dreſſing or Graving will cleave faſt to ſuch oiled Boards.

632. IT would probably be a good Means to preſerve Timber Fabricks, (eſpecially ſuch curious and expenſive Fabricks as that of the Bridge at *Walton* on *Thames*) much the longer from decaying, to cover them with Weather-Boards ſo fixed as to leave ſufficient Spaces for the Air to paſs up freely between them; for wherever the Air can come to dry off the Damp or Wet before it has time to ſoak deep, there the Timber will laſt long, as is evident in the Caſe of the outſide Timber of very old Timber Houſes; but when the Wet continues ſo long as to have time to ſoak in deep, and is alternately dried off and wetted, it

thereby looſens and carries off the Subſtance of the Timber. This may be obſerved in Piles, which are alternately ſometimes for a conſiderable Time under Water, and ſometimes not.

633. In the Preface of Monſ. *Demours*'s Tranſlation of my Treatiſe on Ventilators, I find the following Receipt for careening and dreſſing of Ships, to preſerve them from Worms; which was communicated to the Tranſlator by a Merchant of *Marſeilles*, who affirms he never knew it fail of Succeſs. *Viz.*

634. Take a hundred Pounds Weight of the fineſt Pitch, melt it over a ſlow and ſteady Fire of Coal; when it is thoroughly melted, add to it thirty Pounds of roll Brimſtone groſsly bruiſed, and boil the whole over a Coal-fire till thirty Pounds are waſted. It is nearly boiled enough when it adheres to a Stick dipped into it, and will not run off. For greater Exactneſs the Pot muſt be left to cool, and then weighed, to aſcertain the Diminution of thirty Pounds, till Experience ſhall teach to know when it is boiled enough without weighing; the Scum muſt be continually taken off, as in boiling of Sugar, leſt

it ſhould riſe above the Brim of the Pot; but if its riſing up cannot by this means be prevented, it may be quelled by throwing in a Lump of Fat, and diminiſhing the Fire. The Matter, thus prepared, muſt be kept in Caſks in a dry Place, becauſe it is very ſubject to be ſpoiled by Moiſture.

635. WHEN it is to be uſed, melt a-new the Quantity of a hundred Pounds, and when it is become pretty liquid, add thereto by little and little, thirty-five Pounds of Brick-duſt, or Marble-duſt ſifted, and well heated to take off its Moiſture. Theſe Ingredients are to be continually ſtirred with a Stick, that they may be thoroughly incorporated: and in this ſecond Operation, Wood will ſerve inſtead of Coal-fuel.

636. WHEN this Compoſition is uſed, it muſt be very hot, and the Boards dry. In the caſe of old Ships the Surface of the Boards muſt be burnt, and well ſcraped to get off the old Paying, that the new Compoſition may adhere the better.

637. SOMETIMES the Pitch happens to be too groſs and thick, and ſometimes it is too

liquid: In the firſt Caſe, the Quantity of the Brimſtone muſt be ſomewhat leſſened; and in the other, the Quantity of the Brick-duſt ſomewhat increaſed: but Experience will beſt ſhew what is to be done in either Caſe. The Brick-duſt hardens and petrefies the Compoſition, and renders it impenetrable by Worms.

638. THIS Compoſition will perhaps to the Knowing in theſe Matters, not appear ſo much different from thoſe in common Uſe, as to be regarded. The Pitch and Brimſtone are the ordinary Ingredients in theſe Kinds of Compoſitions, to which every one adds what he thinks fitteſt for his Purpoſe: But this can be no Reaſon why this Receipt ſhould be rejected, ſince a ſmall Difference often produces great Alterations. This Compoſition then may be boldly ſubſtituted inſtead of the common Sorts, ſince it is as good as any of them, and has moreover the Advantage of being tried more than once with Succeſs.

639. THE Perſon to whom I am obliged for this Receipt, had ſo great a Confidence in it, that he uſed it on the Planks of the Ship without ſheathing, (the Charge of which is conſiderable, beſides the Inconvenience of

making the Ship ſail the heavier) and the Succeſs never failed his Expectation. A Trial might firſt be made upon the Sheathing of Veſſels bound for long Voyages.

640. IT muſt be here obſerved, that after a long Voyage, and before a Ship takes in a freſh Lading, you are to make a Search, and repair the Dreſſing in all Places where it is wanting. The Merchant aſſured me, that it never came off from the Part of the Veſſel under Water. But as the Line of the Water in a long Voyage, ſinks more or leſs ſometimes a Foot, in proportion to the daily lightening of the Veſſel, ſome Parcels of it may poſſibly come off from that Part which riſes inſenſibly above the Water, and is expoſed to the Rubbing of the Long-boat, which it may be proper to repair before the Ship puts again to Sea.

641. MR. *Henry Bird*, an ingenious and ſkilful Ship-builder at *Rotherhith*, to whom I ſent this Receipt, ſays that it is a ſufficient Fence, being a Sort of Terras: The only Objection beſides the Expence, is its being liable to break or peel off; this hard Sort of Graving is more apt to do ſo than the more

malleable: the Cables ſometimes rub againſt the Ship's Bows under Water; and other Accidents may make ſome Parts bare, and ſo endanger the whole. He has little Hopes that any Compoſition will be found fully to anſwer the Purpoſe, becauſe the Planks ſoaking ſo long in Water, are ſo filled therewith that at length the Moiſture between the Graving and the Planks throws it off, and in time will take place of all that the Planks can be tinctured with.

642. SALT-WATER will prey upon Pitch, but when mixed with Brimſtone it becomes more ſerviceable. Turpentine and Brimſtone is the beſt Compoſition he has met with, and comes home from a Voyage with leaſt Damage from Water or the Soil. The Method of doing *Eaſt-India* Ships, is by firſt ſheathing, and then filling that Sheathing with ſmall broad-headed Nails, which is about double the Expence of common Sheathing; it is a ſafe and ſure Fence from the Worms, and becomes in a little Time one continued Cake of Ruſt, and is not liable to be damaged by Cables or common Accidents. Sheathing is of great ſervice in preſerving a Ship ſafe and

tight, if there were no Worms in the Sea, and is therefore good in long Voyages.

643. A PERSON who has been much in the *Eaſt-Indies*, informs me that they have there an effectual way to prevent the Worms deſtroying their Ships, *viz.* by paying them firſt with a Mixture of Muſtard-oil, (which abounds there) and Lime of Shells, and Hogs Blood: Rape-ſeed-oil which is cheap, will probably do as well. They then ſheath the Ship; the Sheathing muſt be renewed after ſome Years. He ſays Ships have been thus preſerved for a great Number of Years.

644. IN the *Spectacle of Nature*, Vol. III. p. 130. there is Mention of a Paying for Ships to prevent the Worms, made of Pitch, Train-oil, Tallow and Glaſs, which muſt be often repeated.

645. The *Indians* make uſe of the droſſy Part of Aloes to beſmear the Bottom of their Ships, *viz.* becauſe this Part of Aloes will not diſſolve in Water, p. 58. of the Method of preſerving Drugs. And might not this do well to prevent the Worm?

646. I AM informed that the *Muſcovites* prevent the Worms from eating Planks by ſoaking deep, Oil, or Spirit of Vitriol, and Copperas, while the Planks are wetted and warm for bending.

647. As Verdigreaſe is moſt noxious to all Animals, it might be well to mix it with the Paying of Ships: Or if Copper-filings were mixed with the Paying, Sea-water would turn them into Verdigreaſe.

648. IT might be well alſo to lay Planks to ſoak in Water, ſtrongly impregnated with Verdigreaſe, for if it can be made to ſoak ſome Depth into the Planks, it would be an effectual Means to preſerve them from the Worms.

649. MR. *Andrew Reid*, in his Book on the Acid of Tar, is for the Trial of the acid Juice of Tar, prepared either with Copperas or Oker, to preſerve Ships either from Rotting or Worm-eating; as the *Finlanders* preſerve their Timber-Houſes from decaying 100 and 150 Years, by painting them with Acid of Tar mixed with pulverized Oker, which Acid is everywhere thrown away. If, as

Dr. *Lewis* of *Kingſton* informs me, Oil and Litharge will prevent Moiſture from ſoaking into Fir, then this might be a good Preſervative of Fir-board Sheathing from decaying.

650. THE following is an approved Method to preſerve the Boards and Timber of Out-door Work, *viz.* Melt ſix Pounds of Pitch, add by ſifting one Pound of dried *brown Spaniſh* or Whiting, and a Quart of Linſeed-oil.

651. SOME have propoſed to prevent the Worms eating Ship-planks, by waſhing them often with a Decoction of Arſenick, which will deſtroy Bugs; and it is thought that cold Sea-water will not diſſolve the Arſenick, tho' hot Water will. But it is to be feared that when a Ship is broomed or breamed with Fire to burn off the Filth, that Heat may raiſe noxious arſenical Vapours. Mr. *Reid* informs me, that in *China* they divide their Ships into ſeveral Water-tight Partitions, ſo that the Ship will not ſink if there be a Leakage in one Partition.

652. As Fires frequently happen by the boiling over of Pitch or Tar, the following

Method for preventing the ſame having by repeated Experiments been found effectual, is recommended to the Publick in the printed Propoſals of the *London Inſurance-office.*

653. At the Bottom of the Veſſel, wherein Pitch or Tar is to be boiled, put ſome ſoft Birdlime; then let the Veſſel be heated gradually, that the Birdlime may be diſſolved before the Pitch or Tar boils; which may be known by the riſing of ſmall yellow Bubbles round the Sides of the Boiler; and when they appear, the Liquor will not be apt to boil over.

654. The Veſſel muſt not be filled, but ſome Room left for Boiling; and in large Veſſels, wherein twenty or thirty Gallons are to be boiled, the Depth of ſix or ſeven Inches ſhould be left unfilled; it muſt be kept ſtirring while it is heating, until the forementioned Bubbles ariſe.

655. Care muſt be taken, that nothing cold be thrown into it while it is boiling; ſo that if Brimſtone is to be mixed with it, or any Pitch or Tar is to be added, the Fire muſt firſt be damped or taken away; and

when the Liquor ceaſes to boil, then put in Birdlime proportionable to the Quantity of Pitch or Tar to be added, and taking the Precautions aforeſaid for Boiling.

656. FOR a Barrel of clean Tar, (from thirty-two to thirty-ſix Gallons) or for a Barrel of good Pitch, (about two Cent. and half) four or five Ounces will be ſufficient; but if the Pitch is foul or ſoft, ſix Ounces muſt be put in at a Medium,

one Ounce to { 7 or 8 Galls. of Tar,
½ C. of Pitch.

657. PERHAPS ſome other cheaper clammy vegetable Subſtances may have the like good Effect if made of Barley, Rye, or Wheat-meal; at leaſt it may be well to try the Thing in little in a Pipkin.

A Propoſal for checking in ſome degree, the Progreſs of Fires.

658. THE LATE deſtructive Fire in *Cornhill, London,* bringing to my Mind what I had long ſince thought a probable Means to check, in ſome degree, the ſpeedy Progreſs of Fires; which if it could be effected, would be of great Importance; I made the following Experiment in order to form ſome Judgment of the matter, *viz.* I placed on two Garden-pots a dry Fir-board, which was half an Inch thick and nine Inches broad; and covered nine Inches length and breadth of it with an Inch depth of common damp Garden-earth, fencing this Earth on each Side with two Courſe of Bricks, in order to make a Fire-place to contain the Wood Fuel and live Coals, frequently blowing with Bellows in order to keep the Fire to a vigorous Heat; which was done for two Hours Continuance before the Fir-board was burnt through, when there was only a weak lambent Flame at the under Part of the Board; but it could not flame out for want of proper Fuel, becauſe the Subſtance of the Board was reduced to a brittle Charcoal

by the Heat of the Inch depth of Earth which lay on it, and which hindred the burning Board from flaming: And it was obſervable that the Edges of the Board burnt only with a live Coal like a Match, being hindred from flaming by the Earth which lay upon the Board.

659. MAY it not hence be reaſonably inferred, that when a Houſe is on fire it may be a probable Means conſiderably to retard the Progreſs of the Fire, to cover with Earth the Floors of ſeveral of the adjoining and more diſtant Houſes, which ſtand in the Courſe of the Progreſs of the Flames. The thicker the Earth is laid ſo much the better; but if Time will not permit to lay it more than an Inch thick, then ſuppoſing twenty-ſeven Men to carry each a cubick Foot of Earth, which will be a cubick Yard; that cubick Yard of Earth will cover thirty-ſix ſquare Yards of Floor an Inch thick, which repeated ſeveral Times, would ſoon cover all the Floors of a Houſe: And as the Fire probably mounts with great Rapidity and Fierceneſs up the Stair-caſes, it will be well to lay much Earth on the Stairs, which will give ſome Check, eſpecially as the Earth on the

Stairs and Floors may be wetted by the Fire-engines.

660. AND as Fires often catch from Houſe to Houſe at their upper Parts, an upper Floor covered with Earth, with the Rafters burning on it, will not only flame leſs, but will alſo be the longer in burning to ſuch a degree as to fall on the next Floor; and when fallen there, it will alſo be the longer in burning, on account of the Earth on that Floor; and the Flames alſo will be the leſs, and conſequently will not be ſo apt to fire the next Houſe. This Method muſt doubtleſs be better than to blow up Houſes in order to ſtop the Progreſs of Fire.

661. EARTH may moſt commodiouſly be had, and that free from the uſual Crowd on ſuch Occaſions, either in the back Yards or Cellars, and other Ground-rooms; and Pick-axes, Spades and Shovels, with a proper Number of ſmall Sacks, may lay ready for Uſe with the Fire-engines. If the Sacks are big enough to contain two Buſhels, then a Buſhel of Earth may conveniently be carried in each of them like a Wallet over the Shoulder, with half the Earth at each End.

662. THIS Method might be very ſerviceable where there is no Water, or but little, only ſufficient to wet the Earth.

663. THESE Hints from one who never ſaw a Houſe on fire, will, 'tis hoped, be farther improved by thoſe who have more Experience and Skill in theſe Affairs.

664. I AM informed that it is a common Practice in *Scotland*, in caſe of Houſes on fire, to lay Dung and Muck on the Floors, and to throw Water on it; which, where it can readily be had, muſt be of good Service.

665. AND by a Letter dated *July* 17, 1756, from his Excellency Mr. *Porter*, our Ambaſſador at *Conſtantinople*, to the Rev. Mr. *Wetſtein*, Chaplain to her Royal Highneſs the Princeſs of *Wales*, the Reaſonableneſs of this Practice is confirmed; in which he ſays, *viz.* that though he communicated the Propoſal to them, (which I ſent him two or three Years ſince) yet they did not comprehend the Reaſonableneſs of it: but that in the great Fire which happened there the fourth of that Month, and deſtroyed 22,372 Houſes, their Zeal to ſave the *Patriarchal* Church and the

Greek Church, excited ſome of them, when it was thought all human Means were vain, to throw Dirt on the nearly flat Roofs of the Houſes (which were low) of an intervening Street; others improved on it by firſt wetting the Earth, and then plaſtering it on the Roofs of the Houſes; and thereby ſtopped the Progreſs of the Flames, which with the Fire in the preceding *September*, burnt down two-thirds of the City.

666. CONSIDERING the frequent great Devaſtations by Fire in many large Towns and Cities, it has long been a matter of Wonder to me, that it has not many Ages ſince put Mankind upon ſo obvious and effectual a Remedy to this great Evil, *viz.* the obliging People to build thick Partition Walls of Brick or Stone between all new-built Houſes, as has been wiſely practiſed in *London* for more than forty Years paſt, to the very great Benefit of the Inhabitants.

667. AND would it not be a prudent Precaution in Cities and large Towns already built, eſpecially where the Houſes are only of Timber, to have Partition Walls of Brick or Stone between every tenth or twentieth

Houſe, or in what other Proportion ſhall be thought proper. This to be done at the common Expence of the Owners of the Houſes in every Street.

A Propoſal to try if the Force of Hurricanes *can in any degeee be abated: As alſo to abate the Noxiouſneſs of ſome Kinds of ſultry ſulphureous* Airs *in hot Climates.*

668. BEING INFORMED, that for a Day or two, more or leſs, before the dreadful Hurricanes which ariſe at *Jamaica* and the *Leeward Iſlands*, there is a very hot ſultry Air, to ſuch a degree as to wither the green Leaves; alſo that the Sea is agitated with great Surges: and having ſhewn by ſeveral Experiments in my Analyſis of the Air, that ſuch ſultry Heat in the Air is probably owing to the great Ferment which ariſes between aſcending ſulphureous Vapours and the very cold denſe deſcending purer Air, whoſe expanſive Elaſticity is thereby deſtroyed, and that in great Quantity; and alſo inſtantly,

when the Ferment increaſes to the Degree of exploſive Lightening, which in the time of Hurricanes is great and inceſſant, with only a little Thunder at firſt, (for in proportion to the Degree of *Vacuum* in the Air, Sound will be abated;) this attended with very black Clouds, which are occaſioned as well as the Violence of the Hurricane, by a great Quantity of elaſtic Air's being deprived of its expanſive Force; whereby a conſiderable Degree of *Vaccuum* being made in the Air, which before ſuſtain'd its watry Vapours in a more rare diſperſed State, they are now condenſed into black Clouds: The circumambient Air alſo ruſhing into the Vacuity with great Velocity and Violence from all Quarters, thereby makes thoſe tempeſtuous, rebuffing, whirling Hurricanes, which bear down all before them with Devaſtation and Deſtruction.

669. THESE Circumſtances conſidered, whatever the Event may be on Trial, I hope it will not appear ridiculous, but a Thing worthy of Conſideration; whether, in a matter of ſo great Importance, ſome Means might not be found out to inkindle the ſulphureous Vapours ſome Hours before they would kin-

dle if left to themſelves; and thereby probably to abate the Force of the Hurricane by letting it off thus prematurely before there was too great a Quantity of ſulphureous Vapours collected together, or before the ſulphureous Ferment was arrived to ſuch a degree as to have its greateſt Quantity of Matter ready for Exploſion.

670. Attempts of this kind might be made with Bombs, or Granadoes, ſhot to great Heights out of Cannon, or by Rockets. Some Rockets have been obſerved to mount 1200 Yards up in the Air, which, as well as Bombs, carry a Train of Fire to great Heights up into the Air, and then burſt with Wild-fire in them; which might alſo be put into the Bombs and Granadoes, to try if the ſulphureous Vapours in the Air might not thereby be inkindled; as it is well known that the Flame of a Candle will kindle the like Vapours in Mines, and make them go off with a vaſt Exploſion: Or Paper-kites may be raiſed to a very great Height, by fixing the Line of the firſt Kite to the Body of the ſecond Kite, and ſo on to the third, fourth, or fifth, *&c.* Kite; the lower Kites to be larger and larger than the preceding

upper ones: And a Rocket might be fired by means of a Match at the upper Kite when at its greateſt Height. Piſtol-barrels might alſo by the ſame means be fired off at great Heights.

671. ANOTHER Way of attempting the Thing might be by *Phoſphorus*, or by the violent Efferveſcences which are cauſed by ſeveral Mixtures, particularly ſuch as Copperas-ſtones, *&c.* or Filings of Iron, or Pyrites, with *Aqua-fortis*, or other acid Spirits; the Fumes of which I have ſhewn make a violent Ferment and Efferveſcence with Air, and deſtroy much of its Elaſticity. This efferveſcent Mixture might be put into a ſmall deep Pot fixed to the Pole of a Rocket, or to the Kites; as might alſo *Phoſphorus*. Theſe ſulphureous Vapours being thus carried to great Heights in the Air, might more probably take effect there than near to the Earth, on account of the greater Ferment it is probably in there with the purer Air: And if once inkindled, the fiery Efferveſcence of the Air would ſoon expand with great Velocity as far as the Air was prepared to receive it, on account of the great Quantities of ſul-

phureous Vapours it was there impregnated with.

672. IT is probable, that a conſiderable Quantity of theſe ſulphureous Vapours are not ſo high in the Air as to be above the Reach of Cannon-ſhot; for thoſe who have been on high Hills, have obſerved Lightening to inkindle among the Clouds below them. And as theſe ſulphureous Vapours, which cauſe Lightening, aſcend from the Earth, ſo it is thence probable, as alſo from the ſultry Ferment which is then felt in the Air, that they are in great Plenty in the lower Regions of the Air, but do not uſually inkindle into Lightening till they come to intermix with the purer Air above the Clouds, as is probable from the Event of ſeveral Experiments in the *Analyſis of the Air*.

673. AND whereas, as, it is above obſerved, that the Sea is for ſome Days before a Hurricane, agitated with great Surges; this I think may probably be accounted for by the Fermentation of ſeparate Volumes of ſulphureous Vapours here and there with the purer Air, whereby the Air in thoſe ſeparate Parts being deſtroyed, will cauſe the Sea-

water to riſe and ſwell into Waves, which are again inſtantly repelled downwards by the Force of the Air, which muſt needs deſcend with Rapidity to fill up the void Space. And this is a probable Reaſon why the Sea is agitated in ſome great Earthquakes, as at *Port-Royal* at *Jamaica*, viz. by the like Exploſions of large Volumes of ſulphureous Vapours on mixture with the pure Air, as I have ſhewn in my Treatiſe on Earthquakes.

674. I AM credibly informed, that the ſulphureous Vapours in Sir *James Lowther*'s Coal-mines near *Whitehaven* being apt to kindle into an Exploſion by the Flame of a Candle, they have found means to procure a Light for the Miners to work by, *viz.* by the inceſſant ſtriking Fire with Flints on the Steel Edges of ſwiftly revolving Wheels. Whence we ſee, that ſulphureous Vapours are more apt to be inkindled by ſome kinds of Fire than by others; which ſhews the Reaſonableneſs of trying in this Method all imaginable Varieties of Fires and effervеſcent Mixtures.

675. THE Vapours ariſing from the Effervеſcence of a Mixture of Oil of Vitriol and

Filings of Iron, will be inkindled into a Flame by the Approach of an electrified Body; and Air is electrical alſo by the Flame of a Candle.

676. In *Penſilvania* Mr. *Franklin* having fixed a Veſſel of Spirit of Wine and Iron-wire to the Tail of a Kite, the Spirit of Wine was fired in a ſulphureous and conſequently highly electrical State of the Air. Hence it ſeems probable that the inkindling ſuch a ſulphureous State of the Air, may by ſome ſuch Means be haſtened.

677. IT would be adviſeable to repeat hourly Trials of this kind, *viz.* till the Efferveſcence of the Air was arrived to ſuch a degree as to qualify it to be inkindled by theſe Means, if on trial they ſhall be found to have any Degree of ſuch Efficacy.

678. As to Whirlwinds, ſuch Attempts to check them would be to no purpoſe, becauſe they are not occaſioned by ſulphureous inflammable Vapours, but by Eddies in the Air.

679. IF very ſulphureous Air can thus be inkindled, it might be of great Service in other

Caſes where the long Continuance of ſuch State of the Air is very prejudicial to the Inhabitants, ſo as to make them in ſeveral hot Climates, to wiſh for Lightening; which, as I am credibly informed, is ſometimes the caſe in *Charles-Town* in *South-Carolina*, where the long Continuance of a reddiſh duſky ſulphureous State of the Air makes it very unwholeſome, but becomes healthy again when the Air is purified by Lightening.

680. THE Reaſon why Thunder-clouds are obſerved to go contrary to the Wind, ſeems to be this, *viz.* In that ſulphureous State of the Air much Air being deſtroyed, the watry Vapours are thereby condenſed into darker, thicker Clouds, called Thunder-clouds; and the Degree of *Vacuum* cauſes an oppoſite Wind to ruſh in, which being deſtroyed by the ſulphureous Vapours and the Lightening, more and more black thick Clouds are formed in a Direction contrary to the Wind, till at length they are condenſed to ſuch a degree as to fall down in what are commonly called great Thunder-ſhowers.

Some Experiments and Obſervations on the Princeſs of Wales's *Ice-houſe at* Kew: *And on the Degrees of Coldneſs of a Mixture of pounded* Ice *and* Salt, *and of* Iced Cream.

681. THE WELL of the Ice-houſe is about fifteen Feet deep, and the Height of its Dome the ſame; the Thickneſs of its Crown, Brick and Earth, 6 + ½ Feet.

682. *June* 17, at 12. The Warmth in the Shade near the Ice-houſe, 42 Degrees above the freezing Point, by *Farenheit*'s Mercurial Thermometer.

683. WHEN the Ball of the Thermometer was half an Inch diſtant from the Ice in the Ice-houſe, the Mercury ſtood 4 Deg. above Freezing, or into Thawing; and yet the Ice did not thaw, *viz.* for want of the Acid in the cloſe confined Air: for when acid Salt is mixed with pounded Ice it immediately melts, and that notwithſtanding its Coldneſs at the ſame Time greatly increaſes.

684. When the Ball of the Thermometer touched the Ice, the Mercury ſtood at the freezing Point.

685. Aug. 5, at 11 Morn. The Wind Northerly, the Warmth in the Shade near the Ice-houſe, was 67.

686. In the Houſe near the Crown of the Arch 54, a little above the Straw which lay on the Ice 54.

687. It is of great Importance to have this Straw which lies on the Ice very dry; when therefore it grows damp, it ought to be changed.

688. When the Ball of the Thermometer was put into a Mixture of pounded Ice and Salt, the Mercury was 34 Deg. below the freezing Point, whereas 8 Deg. below Freezing will freeze the *Thames* over, if it continue ſo cold for ſome Days; pounded Ice and *Aqua-fortis* is very much colder than a Mixture of Ice and Salt.

689. It was very obſervable that as the Mixture of acid Salt and Ice melted, the

Cold increaſed to 34 Deg. below the freezing Point, but in ſeven Minutes it began to grow leſs cold.

690. Now 34 Deg. below the freezing Point, is 98 Deg. colder than human Blood, which is 64. Boſom-heat 62.

691. Having placed the Thermometer in Cream without Sugar, when frozen to Ice it was 6 Deg. below Freezing.

692. August 7, at Noon. When the Warmth in the Shade was 72, Cream with Sugar froze 4 Deg. into Freezing, and when taken out of the freezing Mixture, in ſeven Minutes the Thermometer roſe two Degrees, in ſeven Minutes more a Degree more, in ſeven Minutes more half a Degree above Freezing, in 30 Minutes 10 Degrees above Freezing. The Diameter of the Cream in which the Thermometer ſtood, was full four Inches.

693. Could Iced Cream be made as cold as a Mixture of Ice and Salt, if eaten then, it would probably inſtantly kill; for the intenſe Coldneſs of ſuch a Mixture has been

known to maim the Hands and mortify the Fingers of thoſe who have unwarily handled it for ſome Time.

694. AND as Iced Cream is commonly not eaten till about half an Hour after it is taken out of the freezing Mixture, it is probably uſually eaten when it is ſome Degrees into Thawing, and probably more ſo in warm Climates; and as Iced Cream is about 64 Degrees colder than our Blood, it ought doubtleſs to be eaten ſparingly and with Caution: And the like Precaution ſhould be uſed in the drinking of Liquors cooled with Ice, eſpecially when Perſons are warmed with Exerciſe or Labour, many labouring People having been killed by drinking when very hot, cold Beer or Water, which has probably been no cooler than 16 or 20 Degrees above the freezing Point; for common Well-water, and the Warmth of the Earth at that Depth, is about 14 or 16 Degrees; which is the Reaſon why it is neceſſary to have a conſiderable Thickneſs of Straw between the Ice and the Walls of the Ice-houſe.

695. THE Heat of *Holt* Water in *Leiceſterſhire* is 85 Degrees, the *King's Bath* at *Bath*

Bath 82, *Buxton* in *Darbyſhire* 54, *Briſtol* hot Well 47, St. *Winifred*'s at *Holywell* 32. Captain *Ellis* found the Degree of Cold in *Hudſon's-Bay* 88 Degrees below the freezing Point, and Monſ. *Deliſle* found it ſeveral Degrees colder in *Siberia*, viz. 125.

696. July 11, I found the Warmth of the Blood of a Turtle which was killed in the Princeſs of *Wales*'s Kitchen at *Kew*, to be 32 Degrees, *viz.* half as warm as human Blood, and double the Warmth of common Spring or Well-water; the Warmth of the Water in which it was before it was killed, was 36, the Warmth of the Air in the Shade 68: The Lungs of the Turtle are large, and dilate much, the Air-veſicles are as large as thoſe of other Animals which can live a conſiderable time under-water without breathing, *viz.* Frogs, Toads, Evets, *&c.*

An Account of an Experiment ſhewing the ill Conſequence of drinking Tea, *or other Liquors very hot.*

697. I PUT the thickeſt End of a ſmall ſucking Pig's Tail into a Cup of Green-tea, when the Heat of it was 114 Degrees above the freezing Point by *Farenheit*'s Mercurial Thermometer, that is, fifty Degrees hotter than human Blood, which is ſixty-four Degrees, a Degree of Heat, at which the warmeſt Tea is often drank. This Degree of Heat ſoon ſcalded the Skin ſo much, that in leſs than a Minute the Hair ſlipped eaſily off.

698. AFTER cutting the ſcalded Part of the Tail off, which was about an Inch long, I put the ſame unſcalded End of the Tail into the ſame Tea when its Heat was 94 Degrees or 30 Deg. hotter than the Blood, *viz.* above half the Heat of boiling Water, which is 180 Degrees, a Degree of Heat, than which few drink it cooler. This alſo ſcalded the Skin in a Minute, ſo as to cauſe the Hair to come off eaſily.

699. THERE is therefore from theſe Experiments, Reaſon to ſuſpect that the frequent daily drinking of ſuch hot Liquor is hurtful, agreeably to the general Opinion of Phyſicians.

An

An Account of ſome farther Improvements made in the Methods of diſtilling great Quantities of Sea-water *without Ventilation, ſince the Publication of my Book on that Subject.*

700. I FOUND the Heat of the Wreak of boiling Water in the upper Part of a cloſed Boiler, to be equal to the Heat of boiling Water, *viz.* 212 Degrees by *Farenheit*'s Mercurial Thermometer, the Ball of which was held in that Wreak two Inches above the Surface of the boiling Water; but when the Ball of the Thermometer was within two Inches of boiling Water in an open Still without its Head on, and four Inches below the Mouth of the Still, then the Mercury roſe but to 180 Degrees, *viz.* thirty-two Degrees ſhort of the Heat of boiling Water, the cooler incumbent Air continually deſcending among the lighter hot aſcending Vapours.

701. AND finding the Heat of the Air blown through a Worm-pipe twelve Feet long and half Inch diameter, the Worm-pipe Tub being full of ſcalding-hot Water, to be 162, the Heat of the ſcalding Water in the

Tub being 188 Degrees, a like Worm-pipe was fixed in the Head of Mr. *Durand*'s Still, a Pewterer in St. *Martin's-lane*, in order to try whether the blowing ſuch hot Air in Showers up through the boiling Water in the Still, would proportionably increaſe the Quantity of the Liquor diſtilled; but the additional Increaſe was on trial found to be very inconſiderable.

702. I FOUND the Heat of the Wreak of boiling hot Water in a Boiler without a Cover on it, at two Inches above the Water, to be 161 Degrees, *viz.* fifty-one Degrees below boiling Heat; and the Quantity evaporated in boiling an Hour, was 5 + ½ Pounds, the Diameter of the uncovered Pot at the Surface of the Water being 9 + ½ Inches, whereas 6 + ½ Pounds were evaporated in an Hour's Boiling in the ſame Pot when covered with a Lid, which was raiſed ſo as to be open full one-fourth Inch for a Space for the aſcending Wreak to go through. The Heat of the Wreak under this Pot-lid was 212 Degrees, *viz.* equal to the Heat of boiling Water. And Dr. *Langriſh*, on making the like Trials, found that twelve Pints, 5 + ½ Ounces evaporated in an Hour's Boiling from

an uncovered Still, whoſe Wreak was 8 + ½ Inches diameter; but with the Swan-neck Still-head on, fourteen Pints nine Ounces were diſtilled in an Hour. The Heat of the Wreak of my uncovered brewing Copper, when the Water boiled violently, was but 170 Degrees at two Inches above the Water; the Diameter of the Copper at the Surface of the Water, was thirty-one Inches.

703. HENCE it is reaſonable to believe, that when large Evaporations are required, the Quantity evaporated may be conſiderably increaſed by having a Cover to the Boiler punched full of Holes, or oblong narrow Slits like a Nutmeg-grater, with the rough Side uppermoſt; by which means if any of the condenſed Vapour ſhould ſettle on the Out-ſide of the in ſome ſmall degree arched Cover, it would trickle down in the Spaces between the Holes or narrow Slits, to the Channel at the lower Edge, and thence be conveyed away through a Pipe. The Size and Number of theſe Holes or Slits muſt be found out by Experience; the Scum of them muſt not be ſo great as to cool the Vapour under the Lid below, or very little below the Heat of boiling Water.

704. When another Porridge-pot twelve Inches diameter, full of boiling Water, was covered with an inverted Culinder full of Holes, and five Inches deep, the Mercury in the Thermometer was heated by the Wreak only to 180 Degrees, *viz.* thirty-two Degrees ſhort of the Heat of boiling Water: whence it appears that there were too many Holes in the Culinder, ſo as to admit Air enough to cool the aſcending Vapour as much as it was cooled in the abovementioned open Still without its being covered with its Head. There was a ſmall Degree of Damp on the Outſide of the Culinder, but not enough to cauſe it to trickle down.

705. While I was intent on theſe Things, it occurred to my Thought to add to my Still-head, which had a Swan-neck on its Top, a Chanel within-ſide near its lower Part, to receive the condenſed Vapour which ſettles on and trickles down the Inſide of the Head; the Pipe through which the Liquor runs from this Chanel uniting with the Swan-neck, a little before it enters into the Worm-pipe of the Worm-tub; both theſe Joinings to be cemented cloſe with a Paſte, made with a Mixture of equal Quantities of Meal and

Chalk,

Chalk, with a little Salt. By this means near double the uſual Quantity of Liquor was diſtilled, and that without blowing Showers of Air up through the diſtilling Liquor.

706. BUT in diſtilling Mint or Pepper-mint, no more was diſtilled than with the Swan-neck only: Hence it is probable that no more Vapour aroſe through the Maſs of Herbs than what could be carried off by the Swan-neck only; and conſequently the Chanel below within the Head, was of no ſervice towards the increaſing the Quantity of the diſtilled Mint or Pepper-mint-water, though it contributed conſiderably to increaſe the Quantity diſtilled from pure Water; from which a greater Plenty of Wreak ariſes.

707. IT next occurred to my Thoughts to attempt a farther Improvement in Diſtilling, by a Means which I had thought on many Years ſince, and which could moſt commodiouſly be put in Practice in the Head of Mr. *Durand*'s Still in St. *Martin's-lane*, which was well formed for the Purpoſe, it having cylindrical, circular, upright Sides five Inches and three quarters deep, and twelve Inches and one quarter diameter, with an arched

Cover. In the Head of this Still ſix flat Pewter-plates were ſet edgeways about an Inch diſtant from each other, with ſmall Chanels at their lower Edge on both Sides, to receive what Liquor condenſes on and trickles down from their Surfaces into theſe ſmall Chanels, which convey it at each End into the larger circular Chanel. Theſe Partitions were ſoldered at each End, and at the Top, to Liſts of Pewter, thereby to fix and unite them as in one Frame, in a right Poſition, and at proper Diſtances from each other; they were at both Ends half an Inch ſhort of the Sides of the Head, thereby to give room for the Vapours the more freely to aſcend, and come at the Inſide of the Head.

708. The happy Event of ſeveral Trials was, that whereas a Pint of Water was five Minutes in diſtilling in Mr. *Durand*'s Still, when it had only the common lower Chanel within; yet when the Swan-neck was added on the Top, and ſix Pewter Partitions within the Head, then a Pint of Water was diſtilled in ſeveral different Trials in one Minute and forty Seconds, in the Preſence of ſome of the Commiſſioners of the *Victualling-office*; and not long before that, in eleven Trials a Pint

was diſtilled in a Minute and twenty Seconds, with the Variation only of two or three Seconds in each Trial. Sometimes there were diſtilled in the ſame Still at the Rate of four Gallons in an Hour, in which Time only twelve Pints were diſtilled in the common way; and ſometimes the Quantity diſtilled, was in the Proportion of five to two. Theſe little Variations were principally owing to the unavoidable different Degrees of Fire; notwithſtanding which, we ſee the Benefit from theſe thus improved Stills is very great. If therefore we make an Eſtimate of the great Quantities diſtilled, from the Event of the Trials which were made before the Commiſſioners of the *Victualling-office*, of a Pint being diſtilled in ſeveral Trials in a Minute and forty Seconds, which is but one-third of the Time, *viz.* five Minutes, in which a Pint was diſtilling in the common way, that is, at the Rate of twelve Pints in an Hour in the common way, and three times as much, *viz.* thirty-ſix Pints, or four Gallons and two Quarts, by the improved Method; which will amount to fifty Gallons in twelve Hours with this ſmall Still, which is but fifteen Inches diameter within at its wideſt Part, and contains ſix Gallons: and in larger Stills proportionably greater Quantities will be diſtilled. This, ſuppoſing there is no Delay in refilling the Still, and bringing the cold Water to a boiling Heat, which Inconvenience is remedied by Mr. *Wyche*'s happy Contrivance, *viz.* by cauſing the hot Water at the upper Part of the Worm-pipe-tub to run into the Still through a Pipe with a Turn-cock, as faſt as the Liquor diſtills off.

709. POWDERED Chalk, to prevent the riſing of the Spirit of bittern Salt, muſt from Time to Time be put in at a Hole in the upper Part of the Still below the Head, in the Proportion of half an Ounce to a Gallon of Water: This Hole to be immediately cloſed, to prevent any Abatement of the Quantity diſtilled.

710. IF this new diſtilled Water ſhould have a vapid Taſte, it will ſoon be made more palatable by blowing Showers of freſh Air up through it, with a proper Tin Air-box full of very ſmall Holes.

711. BLOWING Showers of Air up thro' the diſtilling Liquor, does not in any degree cauſe the Increaſe of the Quantity diſtilled,

though

though in a common Still it about doubled that Quantity; which remarkable Event Mr. *Durand* and I obſerved in both our Stills, *viz.* probably becauſe the aſcending Vapour is ſo fully ſaturated with Moiſture, that it can contain no more. A happy Event, that ſuch great Quantities of Water can thus be diſtilled without the Trouble of blowing Air up thro' it, in the manner which I have deſcribed in the Book on that Subject: in which Book I have alſo given an Account how readily to ſweeten ſtinking Caſk-water, by blowing Showers of freſh Air up through from an Air-box full of ſmall Holes; by which means alſo I have there ſhewn that muſty Liquors, and the ill Taſte of Milk from ſome kinds of Food of Cows may be cured; and alſo Cream and Milk-ſillabubs eaſily and readily made by the ſame Means, and Fiſhes be preſerved alive, &c.

712. THE Sum of the inner Surface of the Head of Mr. *Durand*s Still, is equal to 324 ſquare Inches; and the Sum of the Surfaces of both Sides of the ſix Pewter Partitions, which are ſix and half Inches broad or deep, is 288 ſquare Inches, nearly equal to the inner Surface of the Head of the Still. Hence

we ſee the Reaſon of the happy Event, that proportionably greater Quantities are diſtilled in equal Times by thus increaſing the inner Surface of a Still-head for the aſcending Vapours to condenſe on, and thereby making Room for the more Vapour inſtantly to ariſe from the boiling Liquor, whoſe Surface was about one-fourth of the inner Surface of the improved Still-head.

713. MR. *Durand* made ſuch a Still-head for the *Britannia*, an *Eaſt-India* Ship, of the following Dimenſions, *viz.* the Diameter of the cylindrical Pewter Head *a n*, *Fig.* 26. *Plate* V. 17 ½ Inches, its Depth ſeven Inches; the Depth of the arched Cover *d*, ſeven Inches; the Swan-neck at *z* ſix Inches wide, its ſmall End *x* is united to the ſtraight Neck *b y*, by the ſhort Pipe *x g*, which is ſoldered at *x* to the Swan-neck, but enters a Hole at *g*, ſo as commodiouſly to be put on and taken off with the Swan-neck and arched Cover *r*; the Neck is 11 ½ Inches diameter, and five Inches deep; the lower Part *c*, on which the Neck is fixed, and which covers the Boiler, is two Inches deep. The ſtraight Neck *b y*, is fixed on one of the Ship-boilers, pointing towards the Ship's Side; and in order to pre-

vent the Inconvenience of the heeling of the Ship, a Pipe *i k* is ſoldered to the Still-head at *i*, and to the ſtraight Neck at *k*; by which means the condenſed Liquor has a free Paſſage from the Still-head, whither the Ship heeled to the Starboard and Larboard Side.

714. IN *Fig.* 27. *Plate* V. is deſcribed the Form and Poſition of the ſeven Pewter Midriffs, which are connected and united in a Frame by the Straps of Pewter *c c c c* near their upper Part, and by the metalline Circle *a a* below, to which they are ſoldered: *dddd* are the ſmall Chanels into which the condenſed Liquor trickles down from both Sides of the Partitions, and thence runs into the large circular Chanel; the middle largeſt of them is ten Inches deep and 15 $\frac{1}{4}$ wide, the leaſt eight Inches deep, eleven wide. The Sum of the inner Surface of this Still-head, and both Sides of all its Midriffs, is equal to 1539 ſquare Inches. The Diameter of the Ship's Boiler, which contains thirty Gallons, is twenty Inches broad and twenty-ſix long; the Surface of the Water equal to 520 ſquare Inches. Mr. *Durand*, from a Still with a like Still-head, about an Inch in diameter leſs than that of the Still in the *Britannia*, diſtil-

led a Quart in two Minutes and half in ſix different Trials, with the Variation only of one or two Seconds.

715. If in ſome Caſes it ſhall be requiſite to have a Still-head to both the Boilers, their Noſes may be joined before they enter the Worm-pipe of the Worm-tub; and if there ſhall be great Inconvenience in ſome Ships in diſtilling from the Ship-boiler, it may be done in a Still fixed above Deck before the Foremaſt, as was done in King *Charles* the Second's Time.

716. Dr. *Langridge* of *Wincheſter*, wrote me word, that he made a new Still-head to his Still, whoſe four Sides were each two Feet ſquare; within which Head he fixed ſixteen Tin Partitions at equal Diſtances from each other, with ſmall Chanels on both Sides at their lower Edges, in the ſame manner as was done in Mr. *Durand*'s Still: the Partitions were each twenty-one Inches broad and high; it had no Swan-neck at the Top. This Head thus prepared, he very properly calls a *Condenſing Chamber*, which being fixed on a Still which was 19 Inches diameter, and contained

thirty-two Gallons. There were diſtilled in ſeveral Trials forty-ſix Pints of Water in an Hour, with inconſiderable Variations of more or leſs; whereas with the old ſpherical Head, which was twelve Inches diameter, with a Swan-neck on it, only $14 + \frac{1}{2}$ Pints were diſtilled in an Hour; ſo that full three to one more were diſtilled by this Means than in the common way, the inner Surface of the improved Still head with ſixteen Partitions, being thirty-ſix times larger than that of the old ſpherical Head, and about fifty times more than the Surface of the boiling Water in the Still: by which means the expanded aſcending Vapour condenſing on ſo large a Surface as faſt as it aſcended, gave room for the Vapour to aſcend the more freely, and in the greater Plenty from the boiling Water. Farther Experience will determine the proper Proportion of the inner Surfaces of Still-heads to the Surface of the boiling Water in the Still, ſo as neither to be too needleſsly large, nor ſo ſmall as to leſſen in any degree the Quantity that may be diſtilled; but it will be adviſeable to have it rather ſomething too big than in any ſmall degree too little. Probably a Still-head with a ſomething leſs inner Surface than Dr. *Langriſh*'s had, might ſuffice;

ſice; which might eaſily be known by making Trials with fewer Partitions. The ſquare Form of Dr. *Langriſh*'s Still-head ſeems more commodious and proper to fix Partitions in than the round, becauſe it allows Space for their being all of the ſame Length.

717. WHILE Mr. *Durand* and I were making theſe Trials, it occurred to Mr. *Durand* to make the following farther Improvement on Mr. *Wyche*'s abovementioned Propoſal, *viz.* to have a moveable round Head to reſt on the upper ſmooth, even Edge of a Hoop, fixed within the Worm-tub about a Foot more or leſs as ſhall be found proper, below the Surface of the Water; and when the Water in the Worm-tub is hot enough, then to fix the moveable Head down on the Hoop, by means of two Sticks whoſe lower Ends are fixed on Hinges, and their upper Ends thruſt through ſmall Pieces of Wood fixed to the Worm-tub, thereby to prevent the riſing and floating of the moveable Head; the important Uſe of which is not only to prevent the Deſcent of the powdered Chalk into the lower Water, but alſo there to ſtir it well with a Whiſk, thereby to incorporate the Chalk with the Water, and to

continue whiſking it, till it, with the Chalk, all run into the Still through an Inch Bore-pipe, where the tumultuary Agitation of the boiling Water will prevent the ſubſiding of the finer Chalk.

718. IN order to find out what degree of Refrigeration this would occaſion in the Still, I made the following Trials in my Waſhing-copper-boiler, which was twenty-three Inches diameter at the Surface of the Water, and contained twenty-two Gallons: In ten Minutes after the Fire was kindled it was heated from 45 to 80, *viz.* 35 Degrees, and in four Minutes more to 94, *viz.* 14 Deg. in the two next five Minutes each 38 Deg. more, and in the next five Minutes 40 Deg. *viz.* to 212 the boiling Heat, in 29 Minutes; then I took five Gallons out in two Pails, which when cooled to 115 Deg. was poured back into the Boiler, which reduced the boiling Water to 17 Deg. below the boiling Heat, and in $5 + \frac{1}{2}$ Minutes it acquired a boiling Heat: The ſame being repeated, and the Water in the Pails poured into the Boiler when its Heat was 160 Degrees, the Water regained a boiling Heat in two Minutes, Whence we ſee that the Delay is not long

in refilling the Still in this uſeful manner, and bringing the Water to a boiling diſtilling Heat; which will alſo be conſiderably ſooner, and perhaps without any Intermiſſion or Delay, when the hot Water runs more gradually into the Still through a Pipe of an Inch Bore. It is adviſeable not to fill the Still very full, nor to make the Water boil very violently, becauſe of the riſing Ebullition, which is the greater on account of the Chalk.

719. THERE are five Ounces and half of Salt in a Gallon of Sea-water, and a Gallon of Water can diſſolve nine times that Quantity, *viz.* $49 + \frac{1}{2}$ Ounces. Hence in the Caſe of Mr. *Durand*'s leſſer Still which holds ſix Gallons, an Eſtimate may be made of how many additional Gallons may be added before the laſt three Gallons are ſaturated, with as much Salt as they can diſſolve, *viz.* with $148 + \frac{1}{2}$ Ounces of Salt, which being divided by $5 + \frac{1}{2}$ Ounces in a Gallon of Sea-water, the Product is twenty-ſeven Gallons; from which ſix Gallons which were at firſt put into the Still, are to be deducted, ſo that twenty-one additional Gallons may from time to time be put in, to bring the remaining three Gallons of Water in the Still to that degree of

Saturation, when twenty-four Gallons will be diſtilled; though perhaps a Quantity leſs than this, may be the proper Quantity: But the more may be diſtilled on account of the great Quantity of Chalk, *viz.* thirty Half-ounces which were put in the Water; but, as Mr. *Durand* rightly obſerved, that about one-third more was in equal Times diſtilled from freſh Water than from Sea-water with Chalk in it, by reaſon the Water does with the more Difficulty extricate itſelf from the fixed Subſtances of Chalk and Salt: ſo if it ſhall be found by Experience that the Sea-water diſtills off ſlower and ſlower in proportion as the Water in the Still grows by theſe repeated Effuſions ſalter and ſalter, and fuller of Chalk, then this too briny Water muſt ſo much the oftener be all taken out of the Still, in order to refill it with more Sea-water.

720. AND in a Thirty-gallon Still, about 120 Gallons of Sea-water may from time to time be added, before the remaining fifteen Gallons in the Still will be fully ſaturated, with as much Salt as they can diſſolve: After which ſeveral Refillings of the reſpective Stills will probably be requiſite to empty out the

too briny Liquor, and then refill the Stills with more Sea-water. Experience will beſt ſhew how often the Refillings are to be repeated. It may accurately be known whether any Spirit of bittern Salt ariſes, by dropping two or three Drops of Solution of Silver in *Aqua-fortis*, in a little Glaſs of the Water: for if there is a very ſmall Quantity of Spirit of Salt, it will ſeize on the *Aqua-fortis*, and cauſe it to let go the Silver, which will then fall in white Clouds. The Goodneſs of the diſtilled Water may alſo be known, by its boiling common yellow Peaſe ſoft. Mr. *Durand* diſtilled five Gallons of good Water from ſix Gallons of Sea-water, in which there were three Ounces of powdered Chalk.

721. But ſome are apprehenſive that this great Improvement in Diſtilling, may be of ill Conſequence in making thoſe deſtructive Spirits cheaper which are already but too cheap: Had not the Improvement been of great Benefit to Mankind in many other Reſpects, I ſhould have been far, very far, from endeavouring after it, or diſcovering it. But ſhould the Event be to make thoſe Spirits cheaper, and conſequently by ſpreading farther, more deſtructive: the Conſequence of

that will be, that the increaſed raging Devaſtation will the ſooner neceſſarily rouſe the Nations to put a ſtop to what muſt be done hereafter: But as yet few of the Nations, whoſe very Vitals are thereby conſuming and deſtroying, endeavour to put any Stop to it; except the Heads of the native *Indians* in *North-America*, who have long repeatedly intreated the *Engliſh* to ſell them no Rum: which is as effectually extirpating of them as the Hornet did the unſubdued Remainder of the *Canaanites.*

722. IF Mankind, inſtead of receiving and entertaining this Peſt with almoſt univerſal Applauſe and Approbation, could prevail with themſelves to be in earneſt to deliver themſelves from it, then much might be done towards it, either by withholding it, or by lowering and weakening all kind of fermented diſtilled Spirits with Water to a ſalutary Degree; as is now practiſed in our Plantations in *America*, in making Punch ſo weak as not to be hurtful; which, when it was much ſtronger, was well known to deſtroy Multitudes. And where the like humane, wiſe, and laudable Practice has been uſed in Ships, it has had the ſame happy ſalutary Effect.

723. What Neceſſity, or even Temptation can there be, to be averſe to the making them wholſome inſtead of being venomous and deſtructive; and that not only of the Lives, but even of the Morals of Mankind? How much therefore does it behove all who have any Concern for the Honour and Dignity of their own kindred Species, any Indignation at its being thus debaſed and diſgraced, any Bowels of Pity for the vaſt Multitudes, not leſs than a Million, that are yearly deſtroyed all over the World by this moral as well as natural, and therefore worſt of all Evils that ever befel unhappy Man, to uſe their utmoſt Endeavours to deliver Mankind from this Peſt? Was there ever a more important Occaſion to rouze the Indignation of Mankind? Can we be calm and undiſturbed, when this mighty Deſtroyer rears up its invenom'd Head everywhere? The moſt zealous Advocates for Drams, even the unhappy beſotted Dramiſts themſelves, the prolonging of whoſe Lives, and whoſe real Welfare both here and hereafter is hereby ſincerely intended, cannot find fault with this well meant Remonſtrance in defence of them, and of all Mankind againſt this mighty Deſtroyer, from one who has long been labour-

ing, and that not without Succeſs, in finding Means to preſerve Multitudes of Lives by various Ways.

724. IT is the juſt Obſervation of a judicious Writer, *viz.* "That this ſlow Poiſon "firſt deſtroys the Strength of the Body, "and then makes Villainy a ſort of Condi"tion for preſerving in Miſery thoſe Lives it "has before made wretched; it is an avowed "Enemy to Induſtry and Honeſty, and ſtrikes "at the Roots of Wealth and Power by ener"vating the Common People, who are Riches "in Peace and Strength in War."

◆

To the Rev. Dr. *HALES.*

O! qui capacem nobilis artifex eludis orcum, &c.

SOUGHT out by *Study* and confirm'd by *Art*,
The Glorious SECRET *You* at length impart;
The *Gift of Heaven* be henceforth its Name,
Well it deſerves that venerable Claim:
O! could the *Muſe* the wond'rous Thought purſue,
Worlds ſhould be told of ſomething *Great* and *New*,
And pay their juſt Acknowledgment to *YOU.*
How will our honeſt TARS rejoice and ſmile,
How boaſt the Genius of their native Iſle!
Methinks I hear them in the burning Zone,
Bleſſing that *Life* which thus preſerves their *own.*
No more in parching Heats to mourn and waſte,
And eye that Water which they dare not taſte;
But boldly take—— by thy propitious Thought,
With Extacy the ſafe luxurious Draught,
Shall quaff each Night the new-invented Bowl,
To worthy HALES *good health——with all my Soul*;
Shall prove to *Indian* Seas what *Thou* haſt done,
And tell thy LABOURS to the *Eaſtern* Snn.

This is thy Praiſe, Name thy Reward, who can?
Who knows the Price of *General Good* to Man?

By Dr. *Richards,* M.D. of *Grantham, Lincolnſhire.*

Directions for ſweetening great Quantities of ſtinking Caſk-water in *Ships.*

725. MENTION BEING made Page 55 in my little Book, *On diſtilling Plenty of Sea-water, and ſweetening ſtinking Water*, &c. that the main groſs Stink of three Gallons of ſtinking Water was blown off in five Minutes, by aſcending Showers of freſh Air blown through a Tin Air-box full of Holes, ſuch as is deſcribed in that Book; and a Bowl full of ſtinking Water being thus ſweetened in two Minutes, which is now much practiſed with great Approbation in many Ships. And Mr. *Littlewood*, a Shipwright at *Chatham*, having ſweetened, as he told me, a Butt of ſtinking Water in an Hour, it is reaſonable to believe that great Quantities of Water ſufficient for the moſt numerous Crews, may eaſily and effectually be ſweetened by the following manner, which would be of great Benefit to their Health; for beſides the nauſeous Diſagreeableneſs of it, putrid Water will have a ſtrong Tendency to produce putrid dangerous Diſtempers, *viz.*

726. To have a Pewter Pipe, *Plate* III. *Fig*. 25. *b. c. n.* about $\frac{3}{4}$ Inch diameter within, with a like Croſs-pipe *d. n.* ſixteen Inches long, with two other like Pipes cloſed at *x* and *z*, made exactly to fit and ſlide on the Ends *d* and *n* of the Croſs-pipe, with a Slit and ſmall Knob at *d* and *n* to fix them faſt, as Bayonets are fixed at the Ends of Muſkets. Theſe long Pipes *x. z.* to have ſhorter lateral Pipes *o.o.o.o.* on both Sides four Inches long, and with ſmall Holes in four long Rows, *viz.* one above, one below, and on each Side, and the ſhort lateral Pipes the ſame; the Holes to be about $\frac{1}{20}$ Inch diameter, at $\frac{1}{3}$ Inch diſtant from each other; but towards the Ends *x* and *z* to be nearer to each other, that the Water may thereby be the more readily drove out of the Tube, to make room for the Air to reach the very Ends *x* and *z*, in which there ſhould be a few of the like Holes; the upright Pipe *c. n.* to have no Holes in it, and to be ſo long as to reach down to the Pipe *x. z.* at the Bottom of the Butt laid lengthways on Deck. When the Ship heels much, it will be well to move the Pipe *x. z.* ſo as to reſt on the then loweſt Part of the Butt, that the Showers of Air may

the better aſcend through the middle of the Water. With the like Pewter Air-pipe eighteen Gallons of ſtinking *Thames* Water were ſweetened in a Kilderkin, by blowing Showers of freſh Air up through it, in fifteen Minutes, in the Preſence of his Excellency Seignior *Mello de Caſtro*, Envoy from the King of *Portugal*, and of Dr. *De Caſtro Sarmento*, F.R.S. Whence we ſee how eaſy it is to ſweeten a ſufficient Quantity of ſtinking Water for whole Ships Crews.

727. THE double Bellows, with two or three ſtrong ſpiral Springs within to contract down the upper Board, to be of the full Size of large Kitchen Bellows, or rather double that Size if needful. My Bellows are 11 + ½ Inches broad in the broadeſt Part, and 15 + ½ Inches long from the Iron at the narrow Noſe End of the Board to the Beginning of the Handle. Theſe Bellows are to reſt on a Block faſtened towards the End of the Butt, and on a leſſer Block near the ſmall End of ths Bellows, to both which they are to be bound faſt with Cords; or they may be fixed by any other Means that ſhall be found more proper. The ſhort Noſe of the Bellows to be

an Inch diameter within, to be united by the leathern Pipe *a. b.* to the Pewter Pipe *b. c.* the Boards of the Bellows to be thick and ſtrong, and the Leather to be ſtrong and ſupple, and very wide, to give room for high and deep Strokes; the Bellows to be lifted up very quick, that the Water may have the leſs time to run into and fill the Pewter Pipe, and if the ſpiral Springs do not contract with Force enough, then a proper Weight muſt be fixed on the upper Board near the Handle of the Bellows.

728. I HAVE found that with two Feet Depth of Water, the Showers of Air may be blown up through it; though it requires ſo conſiderable a Force to do it, that eighteen or ſixteen Inches Depth will do better and ſooner. It will be requiſite to ſtir the Water in the Caſk frequently with a Broom, in order to forward the Sweetening, by thus bringing the more diſtant Water within the Reach of the aſcending Showers of Air: And when one Quantity of Water is thus ſweetened, it may be pumped into ſweet Caſks for Store-water, to make room to ſweeten more. If the Spread of the Length and Breadth of a Butt ſhall be found too large for ſuch Bel-

lows, a Hogſhead may be made uſe of inſtead of a Butt; or, if it were practicable to divide a Butt by a Partition fixed a-croſs in the middle, it might be better for the Purpoſe.

729. GREATER Depths and Breadths of Water might be ventilated with Smiths Bellows, but they cannot well be fixed on Deck without being too cumberſome; and this Operation ought not to be done between Decks, unleſs in well ventilated Ships, or with open Ports; becauſe the mixing the foul putrid Vapours in the Ships with the Water, may endanger the making it unwholſome.

730. IT is probable that the ſame double Bellows properly placed at the Well of a Ship, may prevent the much ſtinking of the Bilge-water, as deſcribed in Page 60 in the abovementioned Book, *viz.* by means of a Pewter or Copper Pipe full of ſmall Holes, laid round the Main-maſt at the Bottom of the Water in the Well, and blowing Air up through it now and then at its firſt beginning to ſtink, when a little Blowing may probably ſuffice; but when it ſtinks much, it muſt be pumped out in the uſual Way,

becauſe Blowing then would raiſe too great a Plenty of unwholſome putrid Vapours.

731. THE Well of the Parſonage-houſe at *Farringdon* near *Alton*, *Hampſhire*, which is ſeventy-two Feet deep to the Water in Chalk, being obſerved to extinguiſh a Candle let down into it, eſpecially when the Springs are low, the Rev. Mr. *Liſſett*, at my Deſire, let down a Candle twice about the middle of *November*, when the Springs were not much riſen, when the Candle was both times extinguiſhed by the noxious Vapours when it was about half way down; he then poured ſix Watering-pots full of Water in Showers thro' the Roſe of the Pot; on letting down a Candle, both an Hour and two Hours after in the Evening it was not extinguiſhed, nor its Light in any degree diminiſhed; the next Morning the Candle was not extinguiſhed till it came down near to the Surface of the Water; he then poured in a Shower, only one Pot-full of Water; after which the Candle deſcended to the Water, and aſcended without any Diminution of its Light. Hence it evidently appears how effectual this eaſy Method will be to cure for ſome Hours the noxious Vapour in Wells, either at their firſt

Digging, or when cleanſed: By the ſame means the deadly Vapour of ſome Bog-houſes may be purified for a ſhort time, as alſo the noxious putrid Vapour in the Well of a Ship: or if there is a like bad Vapour in any other Part of a Ship, or in a Drift, or other Part of a Mine, it may be purified by ſquirting horizontally Showers of Water thro' a Roſe from a Fire-engine. Thus alſo Cities have ſometimes been freed from the Plague by Showers of Rain, which purifies the Air by waſhing down the peſtilential Vapour.

THE END.

Plate III.

Fig. XII.

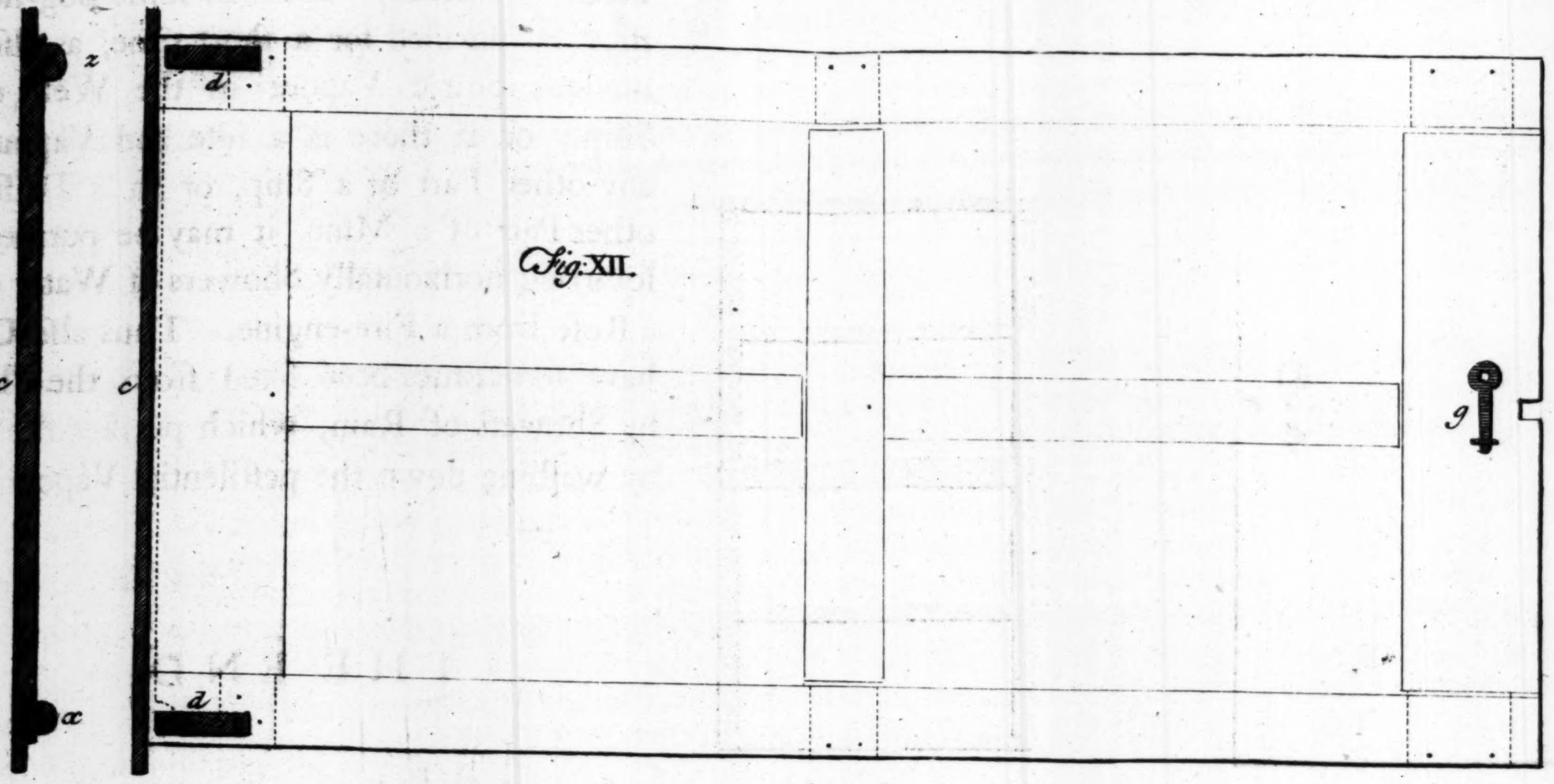

Fig. XIII.

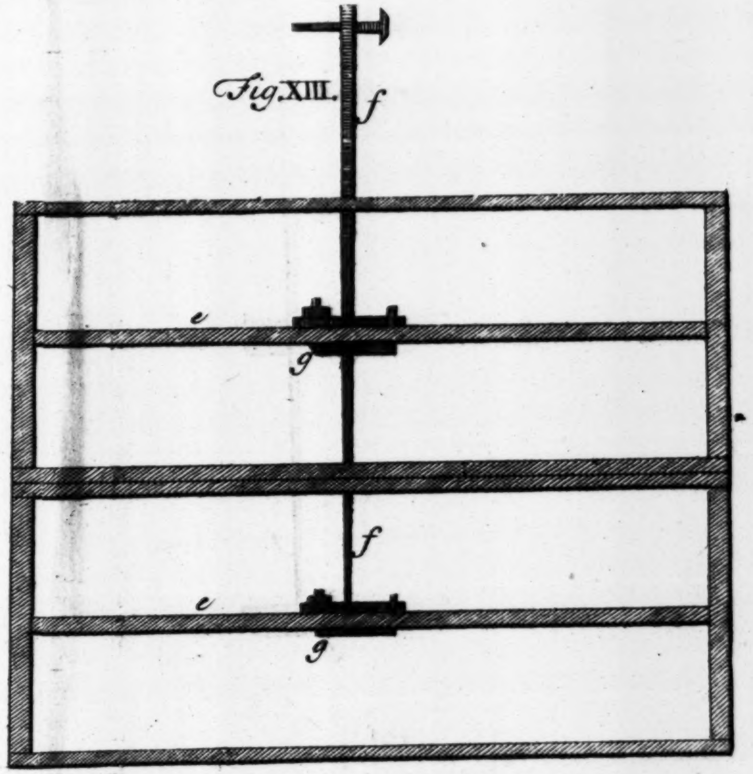

Fig. XXV.

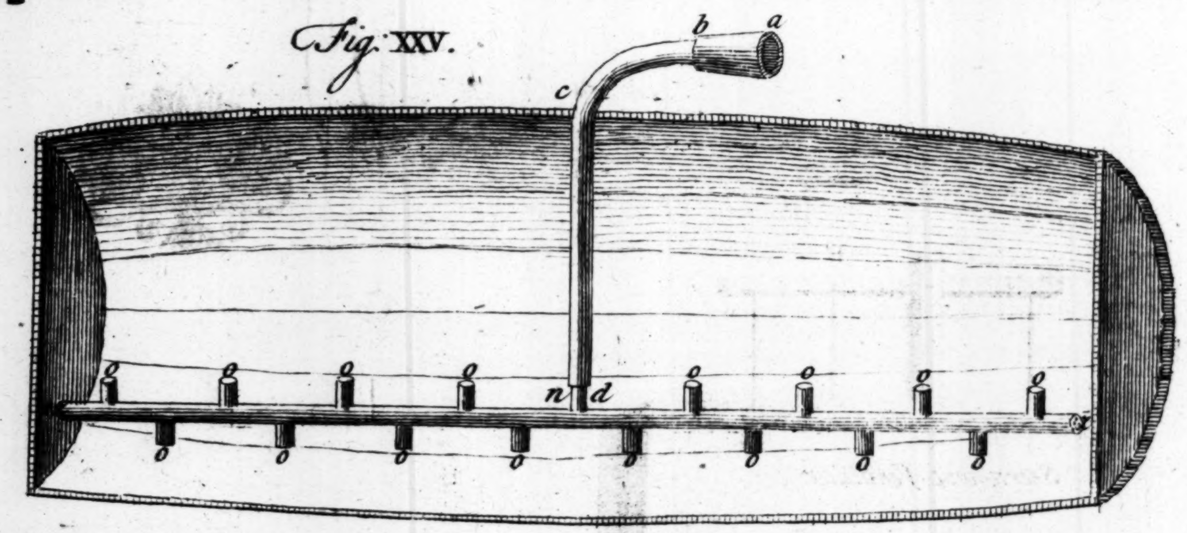

Fig. XVII.

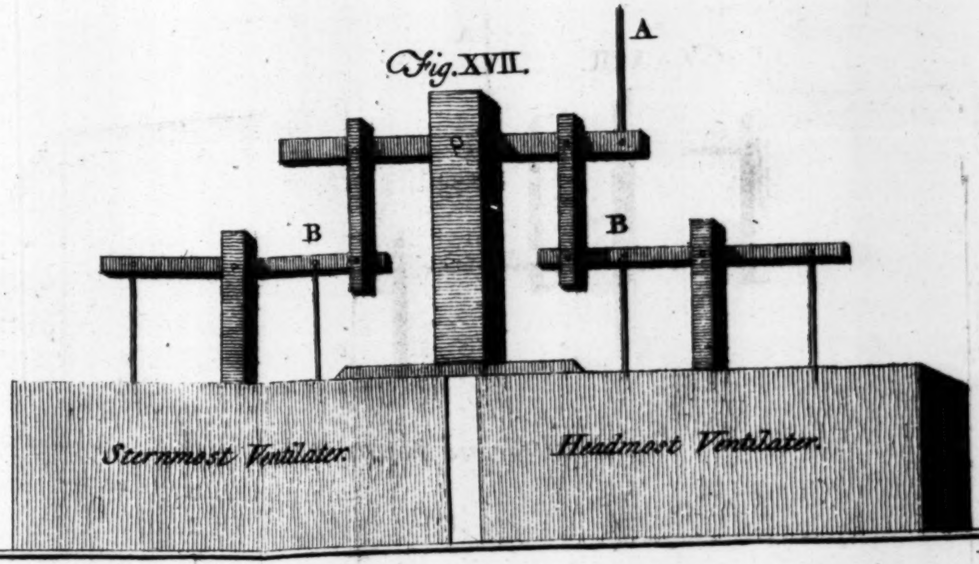

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Plate IV.

Fig. XIX.

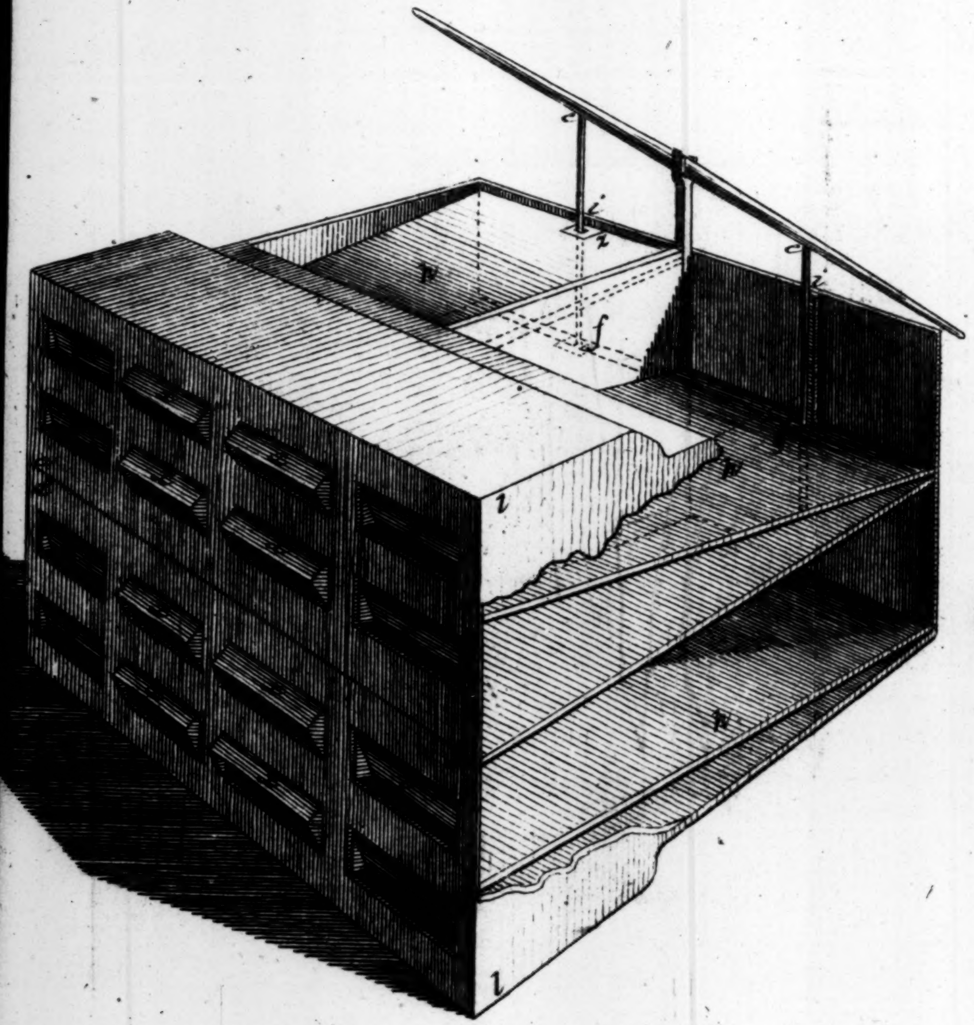


Fig. XX.

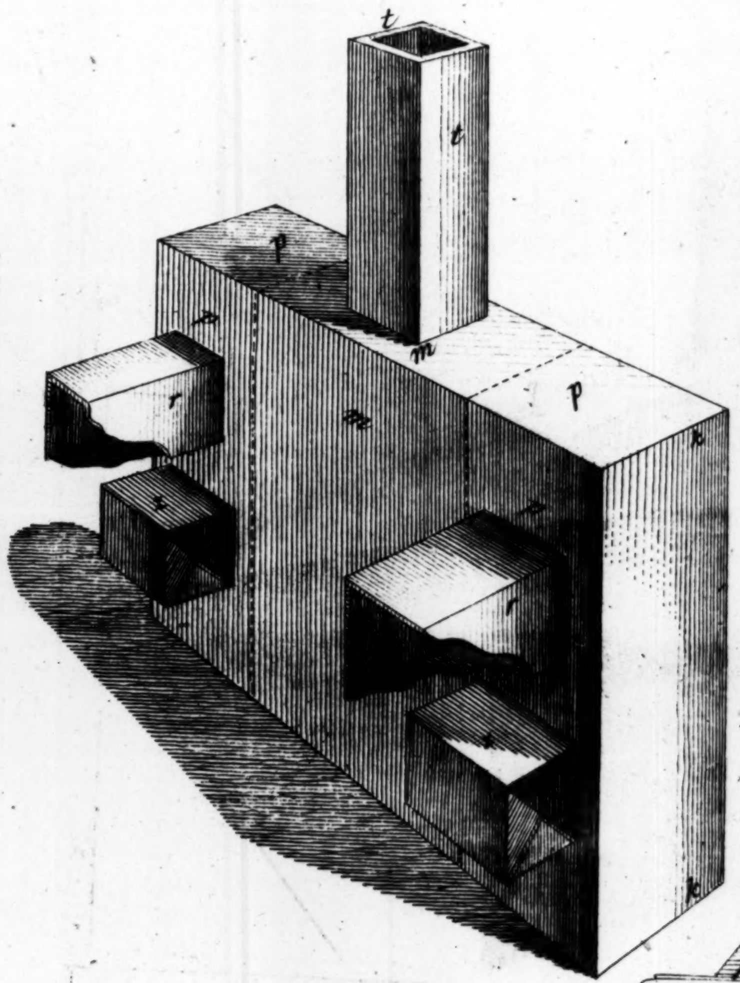
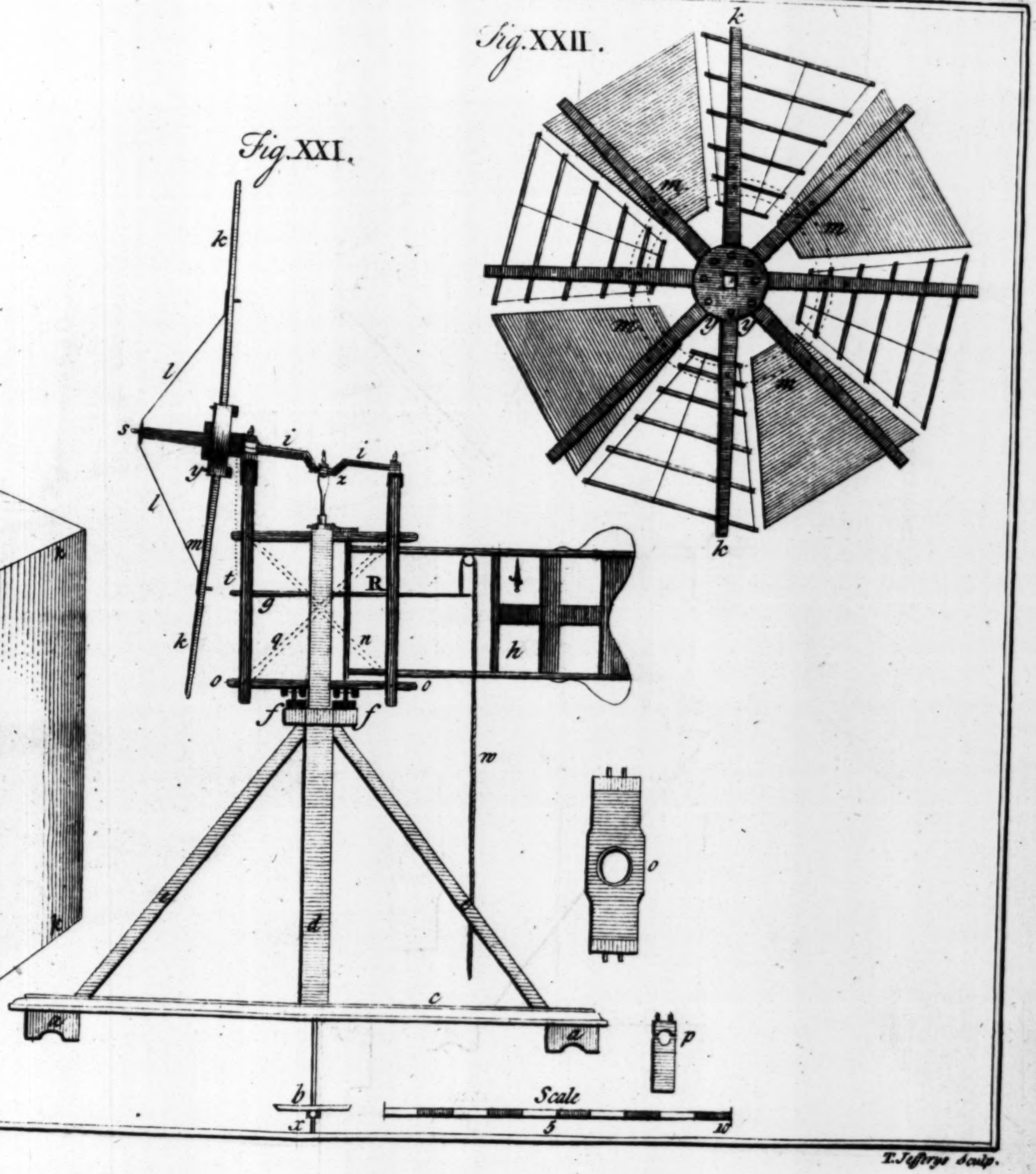


Fig. XXI.

Fig. XXII.



T. Jefferys sculp.

Fig. XXIII.

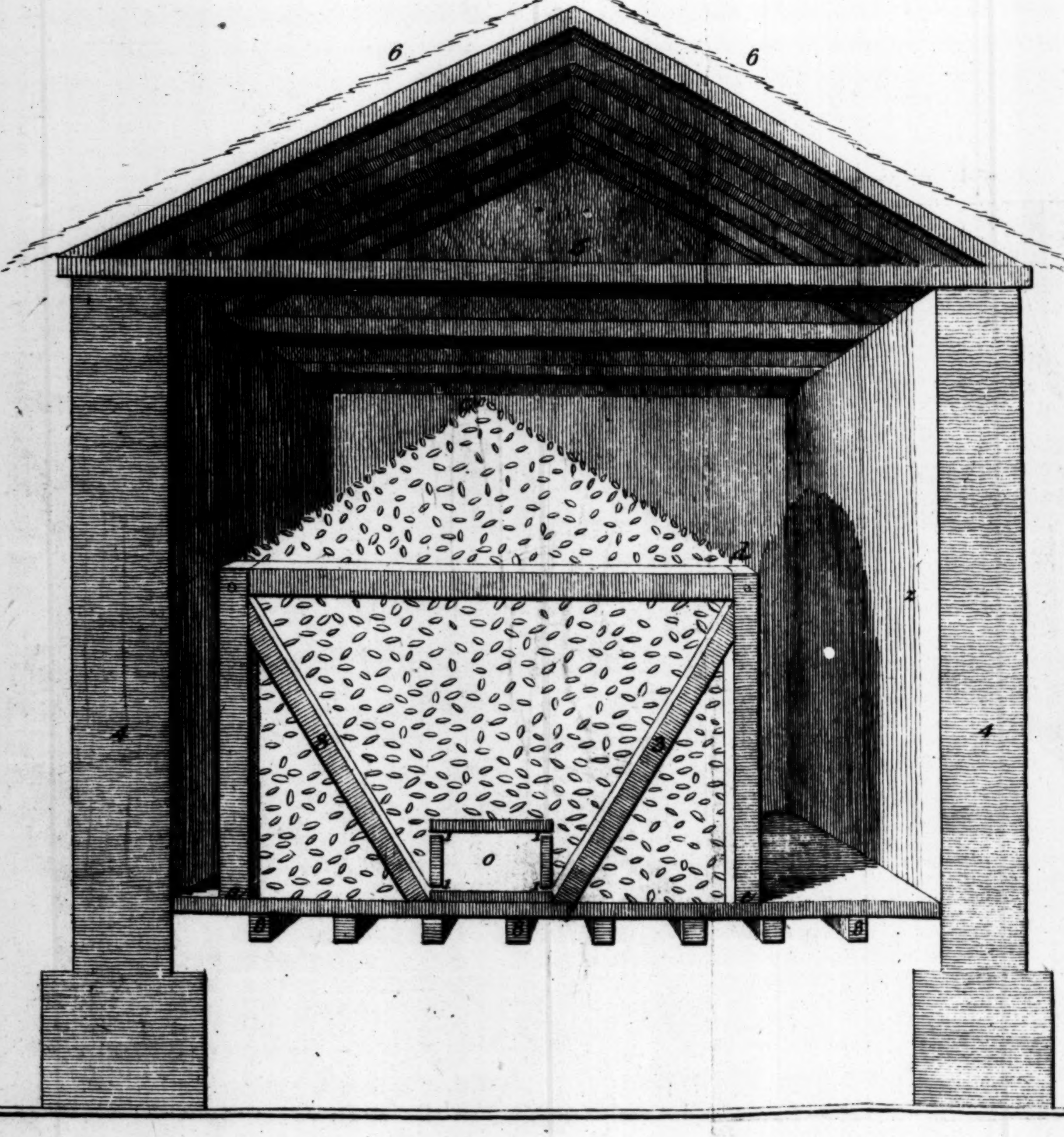


Fig. XXIV.

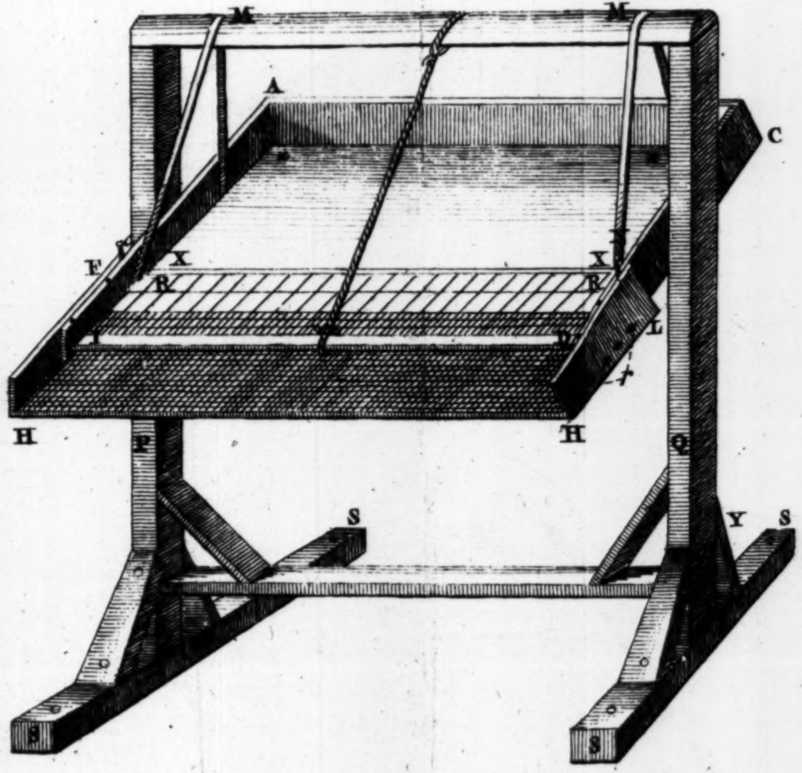


Fig. XXVII.

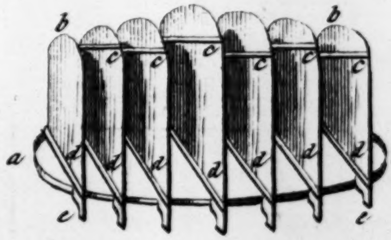
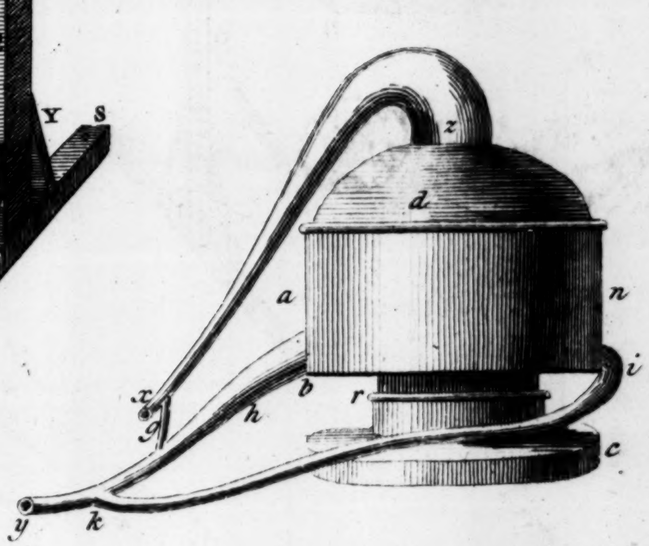


Fig. XXVI.



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G.R. III BR. MUS.

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